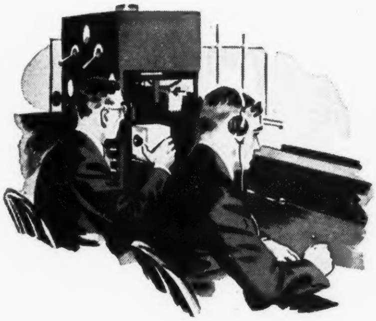
THE CORNELL ENGINEER

COLLEGE OF ENGINEERING · CORNELL UNIVERSITY

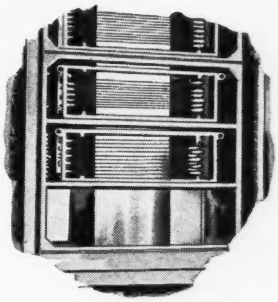
he started something that will never stop

25 YEARS AGO a Westinghouse research engineer started something that was destined to have a profound effect upon the lives of all of us . . . and upon generations yet unborn.
That *something* was radio *broadcasting.*



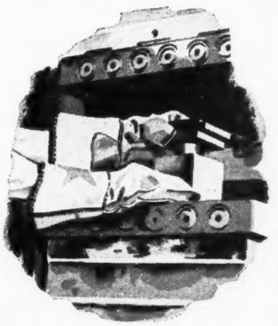
Radio broadcasting was born

on November 2, 1920, when the Presidential Election returns were broadcast from the tiny radio station, KDKA—built by Dr. Frank Conrad at the Westinghouse plant in East Pittsburgh, Pa. It was the first *scheduled radio broadcast* in history . . . the forerunner of a world-wide network that would eventually carry enlightenment and entertainment to the far corners of the earth.



Another "first"

by Westinghouse was the use of radio waves to fuse a mirror-like finish on dull electrolytic tin plate. High-frequency induction heating now helps make *one pound* of war-scarce tin do the work of *three.*

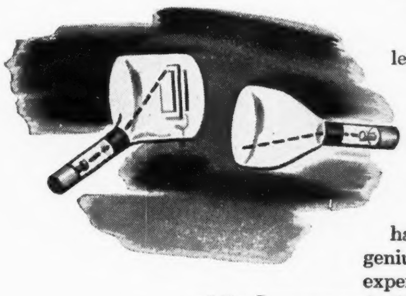


Dielectric death

. . . administered to weevils in grain elevators . . . is another example of the ingenuity of Westinghouse high-frequency engineers. Westinghouse dielectric heating equipment is today speeding the bonding of plywood and curing of plastics and synthetic rubber.

Frequency modulation

was pioneered by Westinghouse scientists as far back as 1920. At that early time they experimented with high frequencies that led the way to the static-free, crystal-clear FM we know today.



Television

has become a reality because of the genius of Westinghouse micro-wave experts, who developed the forerunner of the Iconoscope in 1923 and the Kinescope in 1929. These devices banished forever cumbersome scanning discs.

Research in microwaves

never stops at Westinghouse. Research, begun 20 years ago, resulted in the key electronic tube for the *first* long range Radar equipment. Other secret devices, born of war in the Westinghouse Research Laboratories, will contribute to a better, brighter peacetime world.

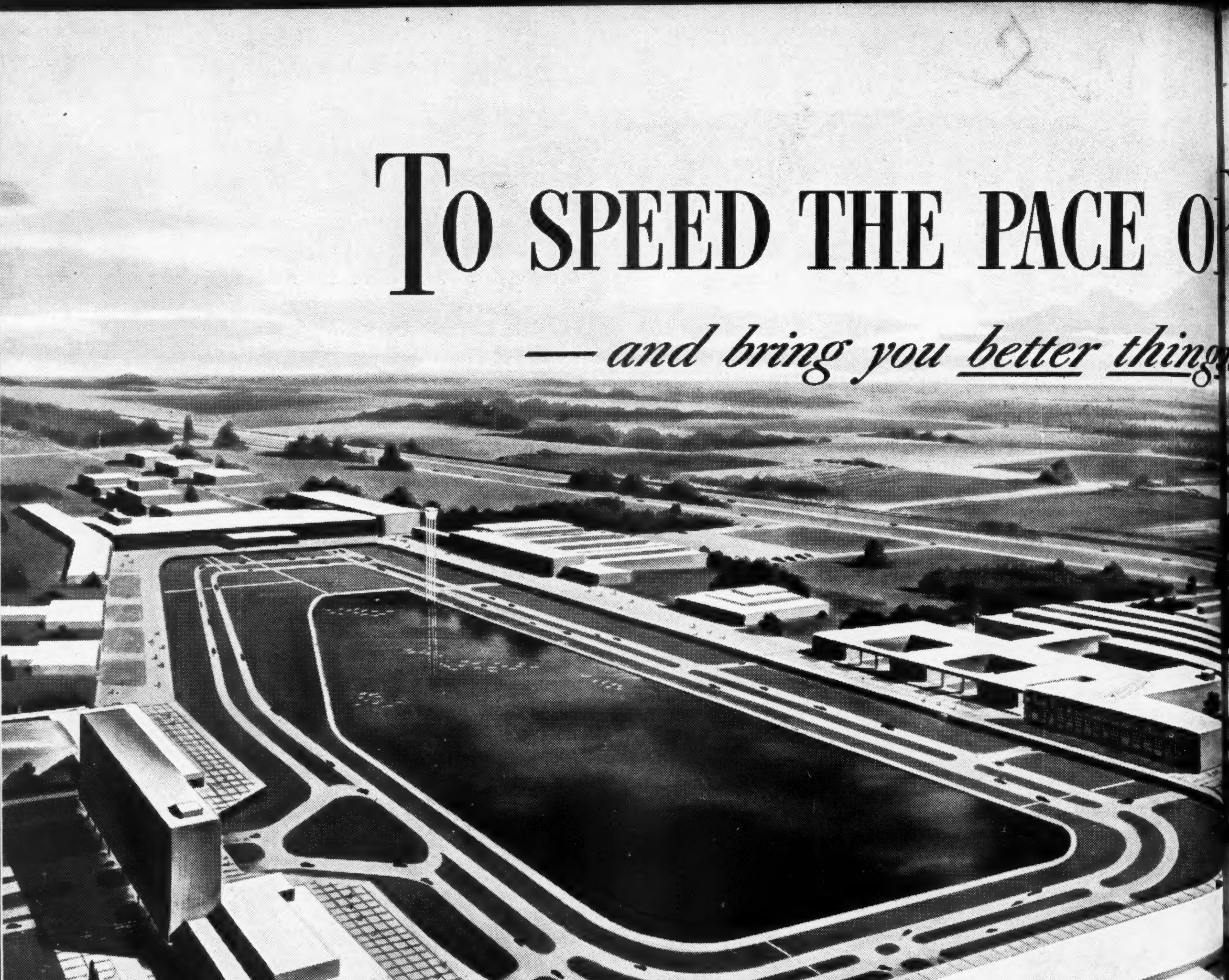
Westinghouse
PLANTS IN 25 CITIES · OFFICES EVERYWHERE

Tune in: JOHN CHARLES THOMAS—Sunday, 2:30 pm, EWT, NBC • TED MALONE—Monday through Friday, 11:45 am, EWT, American Network

937350

TO SPEED THE PACE O PRO

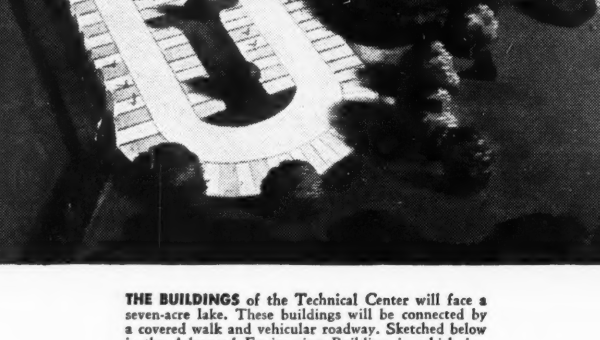
— *and bring you better thing more*

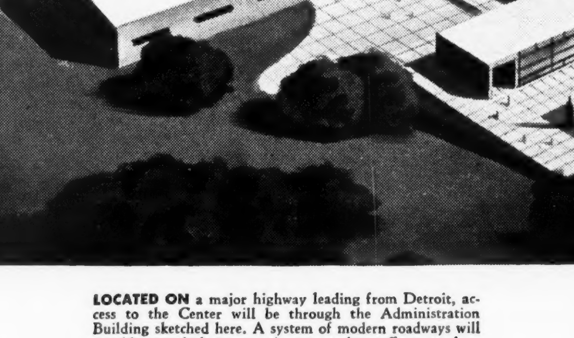


THE BUILDINGS of the Technical Center will face a seven-acre lake. These buildings will be connected by a covered walk and vehicular roadway. Sketched below is the Advanced Engineering Building in which improvements will be quickly made in existing products.

LOCATED ON a major highway leading from Detroit, access to the Center will be through the Administration Building sketched here. A system of modern roadways will provide practical opportunity to study traffic control as well as to make simple road tests of new car developments.

A FLOO
southern
ings whe
in such
phyl, res





The New

GENERAL MOTORS TECHNICAL CENTER

will be created to stimulate opportunities, promote employment and bring about MORE and BETTER THINGS for MORE PEOPLE

THESE are times when the world cries out for new and finer things. There is a great hunger, broad as all mankind, for happier relationships among men — for greater individual opportunity for accomplishment, for more and better goods within reach of everyone.

It is by satisfying this hunger that we can bring greatest benefit to our national economy in the future. Through such action lies the road to more good jobs, to an ever-rising standard of living through the continual replacement of old things with new and better ones.

The General Motors Technical Center is dedicated to such an objective. It will occupy a 350-acre tract of land outside of Detroit as soon as conditions permit. Its purpose is to develop new things that add to the comfort and security of our living, and to enable existing things to be made more efficiently, hence at lower selling prices, so more people may own and enjoy them — all with expanding job opportunities.

It will shorten the time required to bring the work of creative thinkers out of the idea stage and into usable reality.

Here in groups of buildings designed especially for the purpose, General Motors will gather in advantageous and inspiring new surroundings the most modern facilities for research, advanced engineering, styling and the development of new manufacturing techniques.

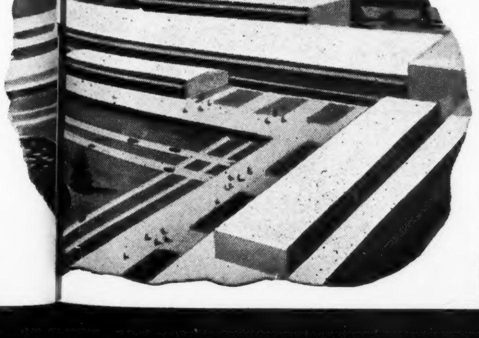
Here physicists and engineers will discover new facts and convert them into new improved products. Stylists will give them new and more attractive form. Process engineers will develop better manufacturing techniques for making them.

Science here will go to work in the interest of economic progress. And history is full of proof that when science is so harnessed, more jobs are created, more comforts and conveniences are brought within reach of more people.

Serving as a source on which the engineering staffs of all of our Divisions may draw, the General Motors Technical Center will stimulate improvement in all General Motors products. Automobiles, refrigerators, Diesel engines, locomotives and other good and useful things may be expected to be improved at even faster pace than in the past.

But the work of the Technical Center will not be confined to existing things. It is dedicated to the idea that progress is the servant of mankind and that whosoever advances it not only helps himself but his fellow men. Its goal will be "more and better things for more people," whether that comes through improvement of the old or development of the new.

A FLOOD OF SUNSHINE will pour into the southern windows of the Research Buildings where experimental work is carried on in such diverse fields as the study of chlorophyl, research into fuels and engine design.



GENERAL MOTORS

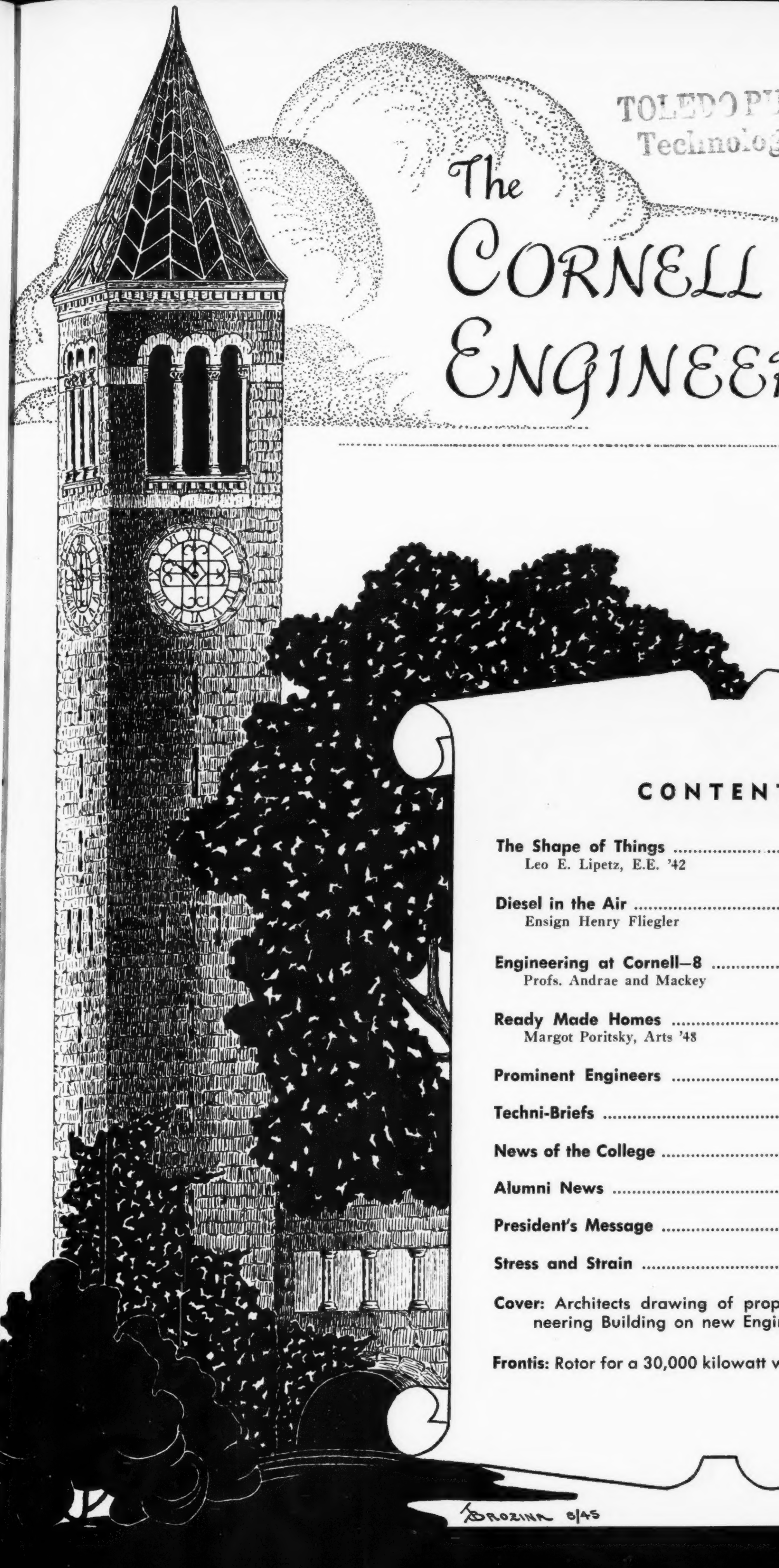
MORE AND BETTER THINGS FOR MORE PEOPLE

CHEVROLET • PONTIAC • OLDSMOBILE • BUICK • CADILLAC • BODY BY FISHER
FRIGIDAIRE • GMC TRUCK AND COACH • GM DIESEL

Every Sunday Afternoon — GENERAL MOTORS SYMPHONY OF THE AIR — NBC Network

MAKE VICTORY COMPLETE—BUY MORE WAR BONDS

The Cornell Engineer



CONTENTS

THE SHAPE OF THINGS

By LEO E. LIPETZ, E.E. '42

EVER look at some gadget and wonder why it was built that way? If you have, this article is meant for you.

In this article we'll dissect machines and gadgets to see how they got that way, and electrical communications equipment will be the guinea pigs. We'll examine the different design requirements put on such equipment by the users and see how those requirements determine the final design.

Machines and gadgets are built because they can be used to help satisfy people's desires. If the designer wants to stay in business, he designs the machines so that they will best satisfy those desires. It's been found from long experience that this will generally be true if the machines are designed to:

(a) Do the job they are meant to do with the required precision.

(b) Work with other equipment when necessary.

(c) Be adapted to the conditions in which they will be used.

(d) Be easy to operate.

(e) Be easy to repair.

(f) Last long enough for the user to feel that his investment has been repaid.

(g) Have a low first cost and a reasonable operating expense.

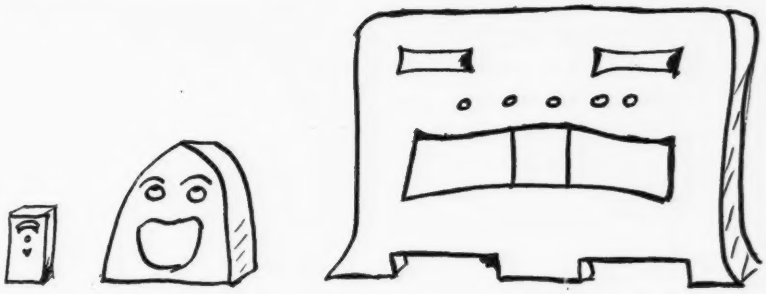
(h) Have a neat appearance.

There are a few hundred other factors that enter into choosing a design, but those given above are the most important.

The catch in choosing a design is that one requirement cannot be satisfied except at the expense of the others. For instance, the device might work better if a thingumabob were added. But then the device would cost more and be too big to fit in the parlor, or wherever it was supposed to go.

The designer meets this problem by studying the various requirements and deciding which are the more important to the users. He then picks a design which meets the more important requirements at the expense of the others, and that's his answer.

Home radios give an illustration of this compromise in design.



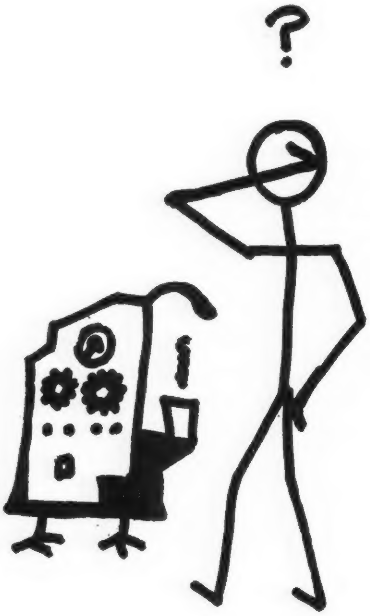
There is a large demand for radios to be used in the kitchen or playroom. These radios will be used mainly for listening to news reports, soap operas, and dance music so the tone quality need be only passable, and only the broadcast band need be received. The radio should be small enough to fit into that space between the refrigerator and the China closet, and the price low enough so that the housewife doesn't decide to use an old radio instead. Because the increased flexibility is more important to many people than the increased operating cost, the designer may make the radio an ac-dc type. This type usable anywhere, eliminates an expensive and heavy power transformer, but uses more electricity than the ordinary ac set. Ease

THE AUTHOR

Leo E. Lipetz graduated from the School of Electrical Engineering at Cornell in 1942. He then went directly to the Signal Corps Radar Laboratory where he helped set up inspection standards for radar equipment. Later he transferred to the headquarters of the Philadelphia Signal Inspection Zone where he did trouble-shooting on the inspection of radar equipment. In 1943 he was appointed a member of the Technical Staff at Bell Telephone Laboratories. He has since been engaged in the development of electric wave filters and their associated test equipment for use in war projects.

Leo E. Lipetz

of operation is important because the busy housewife does not want to bother much with tuning the radio. Therefore it is designed to be operated by two or three simple controls. In this way the users' requirements lead to a kitchen radio design which is cheap, small, and simple.

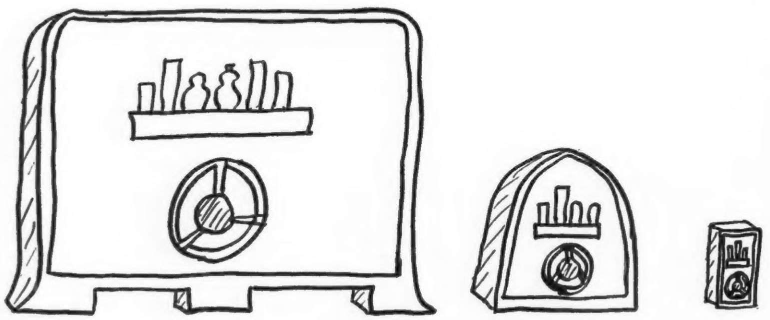


There is also a large demand for radios for the living room. These radios will be used for listening to concert music as well as other programs, and are expected to be impressive pieces of furniture, so good appearance and good tone quality are included at an increase in price. People who like to listen to music on the radio also like to listen to records, so either a record player is built into the radio or the radio is designed to be hooked up to a record player. Then again, most people like to listen in on the short waves once in a while just for the novelty. The designer may decide that a short wave band is enough of a selling point to justify the added cost and include one in the radio. However, many people are not willing or able to pay the increased cost of a console type cabinet as compared to a table cabinet. The designer gets around this easily by making the living room radios in both table and console designs. In this way the users' requirements lead to a living room radio design which is fairly expensive, of medium or large size, of good tone quality, and usually includes special features such as short wave bands, or record players.

However, there are certain requirements that these different types of home radios have in common. They are all expected to select and convert radio broadcasts into the corresponding sounds. They are all expected to work from the house power line, and they are all intended for use in the home where they will be protected from weather and rough handling.

These requirements in common cause the radios to have certain features in common. All the radios use a loudspeaker. All the radios mount their parts on or in a metal chassis. Many of the parts used in the radios are similar. The tubes, sockets, resistors, condensers, and screws are all of similar types.

There is more to that similarity than just the "same problem, same answer" business. The radios were deliberately made similar. It doesn't matter that different companies made the radios. All the radio manufacturers have agreed on certain parts and arrangements which they will make the same. This kind of agreement is known as standardization. The reason for it is simple —it cuts costs.



Here is how standardization cuts costs:

(1) The designer can use parts that are already designed and so saves himself that much work.

(2). The most efficient method of manufacture is to use specialized tools to make large quantities of few kinds of parts. Standardization reduces the numbers of kinds of parts used. The larger quantities of individual parts can then be made by this cheaper method.

(3). The manufacturer and repair shops require fewer kinds of parts and can stock a more complete selection. Before radio tubes were standardized in 1936 you often had to send to the manufacturer for a new tube. Now your corner radio shop usually stocks the tube.

(4). With fewer kinds of parts used, the makers and users of the equipment require less instruction.

(5). Accounting costs are less because there are fewer things to keep track of.

(6). There are certain engineering and operating problems that arise when you try to use together different equipment. Standardization reduces those problems. You can use your electric lamp in any town in the country. That wouldn't be possible if the house line voltages and the wall sockets had not been standardized.

(7). Large supplies of material and trained labor are made available for emergency use by standardization. The Ohio telephone company uses the same standardized equipment and operating methods as do the Indiana, New York, and other Bell System telephone companies. When a flood occurs in Ohio, poles and wire may be sent in by the New York company and trained men by the Indiana company to help repair the damage. Telephone service can then be restored in weeks instead of

months, thanks to standardization.

We see then how standardization reduces costs and speeds repairs. For that reason all industries have some degree of standardization. And for that reason designers use standardized parts whenever those parts meet the requirements on the equipment.

Design Requirements—Reasons and Differences

The requirements placed on the design of equipment depend on what the users of the equipment want to do with it. Let's compare the design requirements of three big users of communications equipment. Those three are the Bell System, Army Air Forces, and the U. S. Navy. For the sake of simplicity we'll consider only airborne equipment for the Army Air Forces and only shipborne equipment for the U. S. Navy. The accompanying list will make it easier to compare their design requirements.

Design Requirement	*Bell System*	*Navy Shipborne*	*Army Airborne*
1. Perform its function	To a precision depending on the function	To a precision depending on the function.	To a precision depending on the function.
2. Must meet requirements as to:			
(a) Space	Small size preferred.	Small size preferred.	Small size essential.
(b) Weight	Of little importance.	Of little importance.	Light weight essential.
(c) Electrical Interconnections	Must work with other telephone apparatus	Some needed.	Few needed.
(d) Temperature	Stand 50°F to 11°F.	Stand —40°F to 140°F.	Stand —75°F to +160°F.
(e) Corrosion	Not serious.	Very serious because of salt water.	Fairly bad.
(f) Shock	Withstand falls in some cases.	Withstand heavy gunfire and shell bursts.	Withstand light gunfire.
(g) Vibration	Not serious.	Fairly bad.	Very bad because of plane motors.
3. Reliability			
(a) Have a life of	About 20 years.	About 5 years.	About 2 years.
(b) Occasional failures	Annoying.	Serious.	Very serious.
(c) Ease of repairs	Important, but cost is primary.	Want fast repairs.	Want fast repairs.
4. Competition			
(a) "Selling points"	None required.	None required.	None required.
(b) Patents	Must observe restrictions.	Use wartime patent pool.	Use wartime patent pool.
(c) Cost	Very important.	Not important.	Not important.
(d) Design time allowed	Enough to do a thorough job.	Hardly any.	Even less.

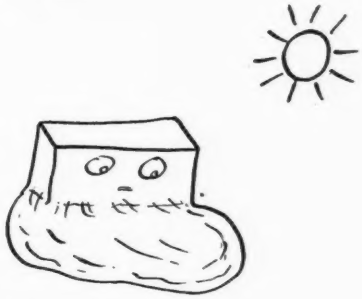
You can see from the list that the chief design requirements for the three users are quite different. Let's examine the reasons for those differences and their effects on the standardization of equipment.

Weight

According to an airline official, his company gains $300 a year for every pound the airplane equipment is lightened. In airborne military equipment reduced weight is even more important. Design a lighter radio for an Army plane and the difference in weight can be used for heavier armor plate and guns. Those little changes often make the difference between a completed mission or death. To get this decreased weight, the designs of airborne equipment have been standardized to use aluminum and the other light metals.

Interconnections

Most military airplanes have intercommunication phones by which the crew members can talk to each other. It would sometimes be convenient if the intercommunications phone could be connected with the plane to ground radio. However, the plane crew can get along quite well without it. In the Bell Telephone System, though, each telephone must be able to connect to every other telephone. Therefore, all Bell System telephones are standardized so that they can be hooked together. The airborne telephones and radios are not so standardized.



Temperature

Temperature requirements give the designers some real headaches.

(*Continued on page* 30)

DIESEL IN THE AIR

By ENSIGN HENRY FLIEGLER

(Graduated with a BS in ME from City College of New York. Formerly with General Electric and was under training in Navy Diesel School, Cornell University.)

ALMOST half a century has now elapsed since Dr. Rudolf Diesel built his first successful internal combustion engine utilizing the principle of compression ignition. During the early development of the Diesel engine the trend was entirely toward large, heavy, low-speed engines, first for stationary and then for marine work. Stationary powerplant engines often weighed as much as 500 pounds per horsepower. Owing to its excessive weight, the Diesel proved too expensive for many uses. Its high thermal efficiency, however, partially made up for its cost and weight. It was not until 1910 that relatively high-speed, lightweight Diesels were produced which had possibilities for further development for aviation.

The first attempt to build lightweight Diesels for aviation was made in Germany by Professor Hugo Junkers during the latter years of World War I. In the United States, the first Diesel aircraft engine was built by the Packard Motor Car Company under the direction of Capt. Lionel Woolson, who in 1929 made the first cross-country flight with a Diesel-engined airplane in the United States. Although the Packard Diesel was abandoned eleven years ago, it still holds the Worlds Non-Refuelling Duration Record for Airplanes of eighty-four hours and thirty-two minutes with a Bellanca cabin monoplane.

The N.A.C.A. has been active with single cylinder Diesel test engines operating on both the 2 cycle and 4 cycle principle. Results obtained show that the 4 cycle air-cooled poppet valve Diesel is practical for aviation.

Capt. L. M. Woolson and W. E. Lees with first airplane to fly with a Diesel engine, the Stinson-Detroiter monoplane.

The application of the Diesel engine to aviation has been relatively slow mainly because of the difficulty of reducing its weight sufficiently to enable its use in the air. Through constant research and development great strides have been made toward solving this problem. Due to the greater maximum pressure obtained in a Diesel aircraft engine, and the fact that the Diesel requires between 25 to 50% excess air for satisfactory operation, most experts today agree that in order to be equally as safe and reliable as the gasoline engine of the same power output, the Diesel engine must be built heavier and larger. Today the most weight-efficient Diesel aircraft engine weighs 1.6 pounds per horsepower as compared with 1.1 pounds per horsepower for a gasoline engine of the same piston displacement. There is little reason to doubt however that future gains in weight-efficiency, through refinement in metallurgy and design, are possible for the Diesel aircraft engine.

Advantages

Mechanically, the Diesel aircraft engine has several distinct advantages over the gasoline engine. The Diesel in aviation completely eliminates electrical ignition troubles and interference with radio communication, since it requires no electric ignition system. The Diesel uses air heated by compression in its cylinders for igniting its fuel. Even the most efficient methods of shielding (surrounding every current carrying conductor of the ignition system by a sleeve or shell of conducting material) employed to eliminate ignition intereference in gasoline-engined airplanes leaves much to be desired. The superiority of the Diesel engine in this respect will be even more noticeable

in the future than it is today. As the length of flight increases so will the distances over which signals must be received be increased, and th's matter of interference originating in the engine itself will become increasingly important.

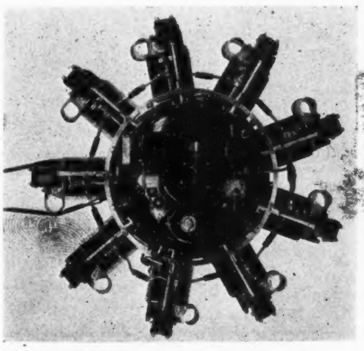
The Diesel also eliminates carburetor troubles. In the gasoline engine there is one carburetor feeding all the cylinders, and if this carburetor develops trouble all the cylinders are affected. In the Diesel, however, each cylinder has its own fuel pump, and if any one pump goes out of commission, the engine is very likely to continue functioning. As the fuel is supplied to the cylinders under high pressure, the engine will function perfectly whatever position the airplane may be in. There is no possibility of vapor lock in the fuel lines between the fuel tanks and the pressure pumps as the fuel oil is non-volatile at ordinary atmospheric temperatures. Also the possibility of ice formation on the air intakes of the Diesel aircraft engine is negligible inasmuch as there is no drop in temperature caused by the evaporation of highly volatile fuel.

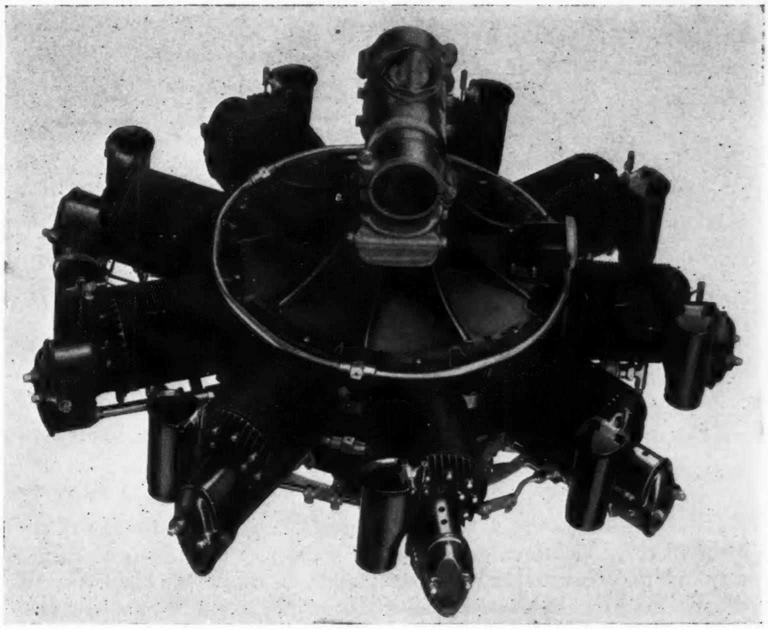
In the Diesel aircraft engine the exhaust gas temperature is around one thousand degrees Fahrenheit as compared with sixteen hundred degrees Fahrenheit for the exhaust gases of a gasoline aircraft engine. This lower temperature permits the use of exhaust-driven superchargers with Diesels.

The advantages of the exhaust-driven supercharger for aircraft engines have been apparent for many years and numerous attempts have been made to utilize this means for boosting their power output. In

Rear view of Packard Diesel aircraft engine

—Courtesy Packard Motor Car Co.





—Courtesy Packard Motor Car Co.

Front view of the first Packard Diesel aircraft engine

the case of the gasoline aircraft engine, it has been difficult to obtain materials for the turbine wheel and its blades which would withstand the high temperatures of the exhaust gases. In case of the Diesel aircraft engine, this difficulty does not exist inasmuch as the exhaust gas temperature of the Diesel is approximately 40% less than that of the gasoline aircraft engine. This lower exhaust gas temperature is a result of the inherently greater thermal efficiency of the Diesel, due to its high compression ratio, and the more complete combustion of fuel and conversion of thermal units into mechanical energy. The problems of cooling the engine are also considerably reduced since there is less waste heat to dissipate. This in turn permits the use of smaller radiators and cooling surfaces, and thereby tends to reduce the weight of the engine.

The Diesel requires no warming up period, which is so necessary with gasoline engines. The Diesel can carry its full load immediately after starting, whereas the gasoline engine has to be run for a considerable length of time in order to bring it up to its normal working temperature before a take-off can be made. The Diesel engine has, on the whole, a much greater adaptability to diverse flying conditions. These advantages are of prime importance in wartime.

Economically, the advantages of the Diesel aircraft engine center chiefly around the characteristics of the fuel which it uses. Not only is the cost of Diesel fuel considerably lower than aviation gasoline, but also the fuel consumption is less due to the more efficient utilization of the thermal units contained in it.

Fuel

For satisfactory operation the high-speed Diesel requires an ordinary commercial grade petroleum fuel oil costing in the United States, five cents per gallon (tax excluded) as compared with eleven cents per gallon (tax excluded) for 87-octane aviation gasoline. Gasoline aircraft engines using 87 octane gasoline have a fuel consumption of .45 pounds per horsepower hour, where as Diesels use only .35 pounds per horsepower hour. Diesel fuel oil has the added advantage of being available practically all over the world, and in case of emergency kerosene may be substituted for it. It also occupies less space than gasoline because of its higher specific gravity. Diesel oil weighs approximately seven pounds per gallon (gasoline weighs about 6

(Continued on page 28)

Engineering At Cornell

8. Mechanical Engineering Laboratories

By PROFESSORS WILLIAM C. ANDRAE and CHARLES O. MACKEY

THE Cornell concept of training in mechanical laboratory may be traced to Robert Henry Thurston and his first experimental engineering laboratory at Stevens Institute of Technology. When President Andrew D. White brought Dr. Thurston to Cornell as Director of Sibley College in 1885, he also brought Thurston's idea of an experimental laboratory which has been described by Dexter S. Kimball, former Dean of the College of Engineering, in the following words: "the experimental laboratory that he established and which was the prototype of many that followed did more than anything else to develop the type of engineering mind that made Cornell famous."

Early History

It was no accident that President White found a man with practical plans concerning training in experimental engineering. He was looking for a man who had ideas about engineering education similar to those shared by himself and Ezra Cornell. In the "Autobiography of Andrew D. White" will be found the essence of this thought in words attributed to a "shrewd artisan": "When a young mechanical engineer comes among us fresh from college only able to make figures and pictures, we rarely have much respect for him: the trouble with the great majority of those who come from technical institutions is that they don't know as much about practical methods and processes as we know."

In recalling some of the early ideas of education at Cornell, it might be of some interest to Cornell alumni and instructors to read the eight features of the University presented in the "First General Announcement" (1868). Two of the eight are quoted here:

"First. Every effort will be made that the education given be practically useful. The idea of doing a student's mind some vague general good by studies which do not interest him, will not control. The constant policy will be to give mental discipline to every student *by studies which take practical hold* upon the tastes, aspirations and work of his life.

"Fifth. There will be no petty daily marking system, a pedantic device, which has eaten out from so many colleges all capacity among students to seek knowledge for knowledge's sake. Those professors will be sought who can stir enthusiasm, and who can thus cause students to do far more than under a perfunctory piecemeal study."

The aims of Cornell, White, and Thurston were largely realized under the successive heads of the Department of Experimental Engineering. Professor Rolla C. Carpenter was hired by Dr. Thurston in 1890 to head this department,

THE AUTHOR

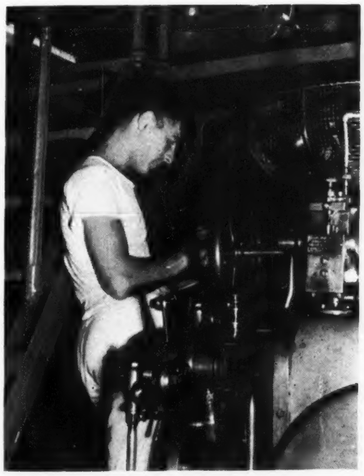
Prof. William Cook Andrae graduated from the Baltimore Polytechnic Institute in 1912, and received his ME degree in 1915 and later his MME degree in 1924 from Cornell University. He was awarded the Edgar J. Meyer Research Fellowship at Cornell in the years 1915-1916. Prof. Andrae's engineering experience has included positions as Chief Draftsman, U. S. Bureau of Standards; Research Assistant, City of Cleveland; and he has worked with the National Aniline and Chemical Co., the White Motor Co., and the Goulds Pumps Co. He became an instructor in the Department of Experimental Engineering in 1921 and was later appointed an Associate Professor in 1927. Prof Andrae is the author of "Thermal Efficiency of an Injector" published in the Sibley Journal, and is co-author of "Experimental Engineering."

Prof. Andrae

Note: Prof. Mackey's picture and biography will appear with another article by him in a subsequent issue.

and for twenty-seven years he developed and strengthened the Mech Lab courses; he hit target one dead center in the General Announcement. Herman Diederichs, '97, who was appointed Instructor in Experimental Engineering in 1897, succeeded Professor Carpenter in 1917. For forty years, "Deed" devoted his life to Cornell. As a teacher of Experimental Engineering, as head of the Department, as Director of the Sibley School, as Dean of the College of Engineering, as a guiding spirit in every worthwhile student organization, and as a member of important committees of the University Faculty, Herman Diederichs scored a bulls-eye on target five of the General Announcement.

Other colleges have copied the laboratory methods developed at Cornell, but few of them have main-



Taking data on a refrigerating compressor test.

tained a separate staff of instructors, chosen for their ability in setting up experimental apparatus and in teaching the practical approach to engineering theories. It was through the maintenance of such an instructing staff singly devoted to this practical approach that the laboratories of Cornell were able to maintain their unique position among college laboratories. When World War II began, instructors required by the Navy in its very practical type of laboratory instruction were supplied from the regular staff of instruction at Cornell. Engineering laboratories have been used in various ways in different colleges. In some schools, the aim has been to demonstrate the theory taught in other courses; experiments are often carried on by the instructor, or by a mechanic under the instructor's direction, with the student a more or less interested bystander and physically removed from the apparatus. In some other engineering schools, laboratories are used as income producers and for advertising; the danger then is that the instruction of the student may be slighted in favor of commercial tests.

After the untimely death of Professor Adam C. Davis in 1942, a complete reorganization of the Department of Experimental Engineering became desirable. The importance of instruction on the properties of engineering materials had so grown that a new Department of Engineering Materials was created, and Professor John R. Moynihan, '26, was made head of this new department.*

To handle the laboratory work on instruments and engines given in the old Junior Mech Lab course as well as the experiments previously given in Senior Mech Lab, a second new department was created as an off-shoot of the older parent department; this department is called the Mechanical Engineering Laboratory Department with Professor Charles O. Mackey, '26, in charge.

Navy Curriculum

In the past, there has been criticism of the Cornell curriculum by a few who thought that Mech Lab was overemphasized. It is interesting to compare the laboratory courses in the Navy V-12 curriculum required of engineer specialist candidates (steam and internal combustion engines) with the laboratory courses previously required by Cornell to cover about the same field for the degree of Bachelor of Mechanical Engineering. The V-12 engineer specialist candidate must receive nine hours per week of laboratory instruction in each of his last three terms.

An engineer specialist candidate in steam and internal combustion

Demonstrating oil burner in steam generating unit.

engines taking the Navy V-12 curriculum received a total of 405 hours of laboratory instruction. Actually, before the war, an undergraduate student in mechanical engineering at Cornell received 75 hours of mechanical laboratory instruction on hydraulic, steam, and combustion apparatus. This scarcely looks like overemphasis upon instruction in mechanical laboratory at Cornell. The essential difference in approach is that the V-12 student was not supposed to spend much time outside the laboratory in writing reports on the mechanical equipment demonstrated, torn down, assembled, or tested in the laboratory, while the pre-war Cornell mechanical engineering student spent from 4 to 8 hours of report writing *outside* of the laboratory for every one hour spent in physical contact with the apparatus in the laboratory.

Most of the instructors who have had experience in any of the Navy training programs, V-12, Diesel, or steam, are agreed that if Cornell is to continue to point the way in laboratory instruction, undergraduate students must receive more, not less, instruction *in* the laboratory, and spend less time writing reports *outside* of the laboratory. There are many reasons for this point of view.

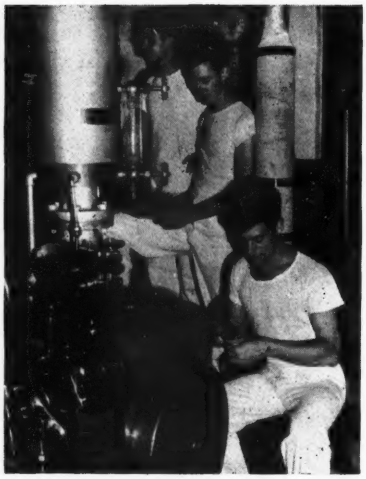
Practical Experience

There has been a growing tendency for students to enter the engineering schools with less and still

*See "Materials Laboratory" Cornell Engineer, 1944.

less practical, mechanical experience. In the early days, many undergraduate students had shop experience or had at least rebuilt or otherwise slightly modified their own "jaloppies." These students had a greasy acquaintance with machine parts and a working, mechanical vocabulary—not entirely profane. The depression years made it difficult for the students to obtain mechanical experience in the summers. Automobiles have become too expensive and complicated for the amateur mechanic. Most students now completely lack fundamental mechanical concepts, although they are very eager to acquire practical experience, and are not afraid to soil their hands in the act. Unfortunately for the engineering profession, there was, during this same period, a growing overemphasis of theory. No thinking teacher will underestimate the importance of a sound training in fundamental sciences like mathematics, physics, chemistry, mechanics, materials, and thermodynamics. It is in applying these sciences to engineering that sound instruction in shop and laboratory must not be neglected in favor of the "slide rule, chalk, and eraser" courses. Tables of integrals are valuable to the engineer but not stimulating to the engineering student. The student generally expects to "see the wheels go 'round" in the course of his engineering training. The engineering school that fails to stimulate an interest already present in mechanical equipment by delaying or shortening the period of student contact with such equipment will fail miserably in its training of engineers.

It is recognized, of course, that the sights in the Navy training courses were set for maintenance and operation of mechanical equipment. The pre-war engineering student was being trained more for design and production. At the same time it is felt that the experience acquired by the teachers in the Navy training programs will be very valuable in laboratory instruction in the post-war period. It is already clear that much more laboratory instruction might be given on maintenance and operation. Not all of the time should be spent in the laboratory on "code" testing or



Group testing a refrigerating compressor

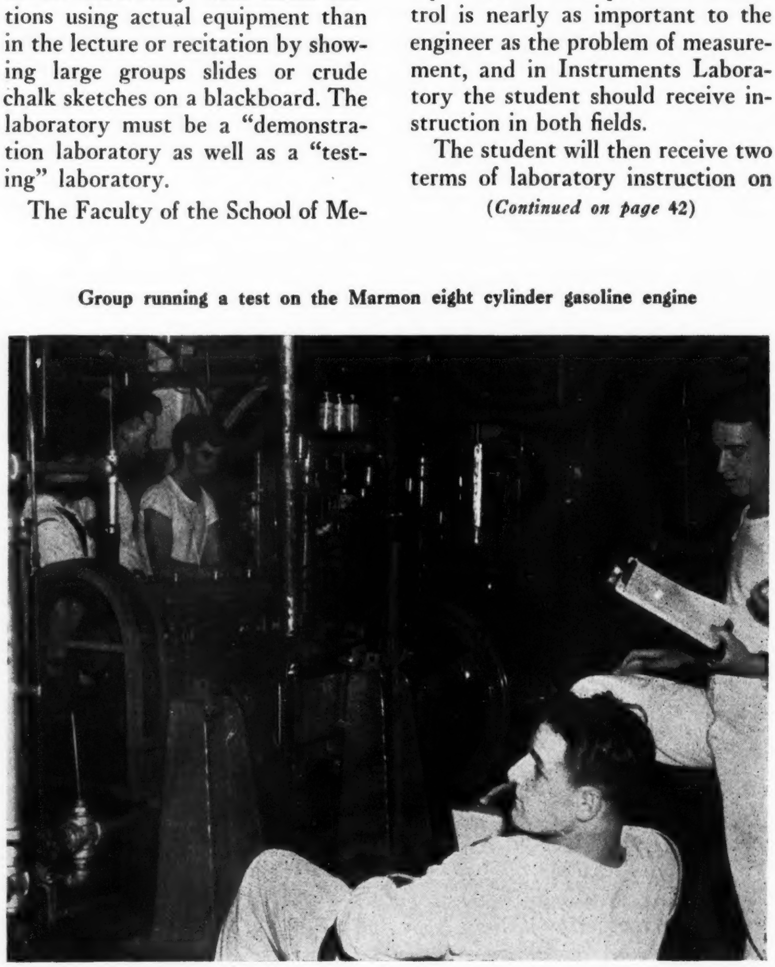
on testing the overall performance of mechanical apparatus. Instead, much more time must be spent in showing the students the features, functions, and operation of the many component parts of the complete machine. This is better done in the laboratory with small sections using actual equipment than in the lecture or recitation by showing large groups slides or crude chalk sketches on a blackboard. The laboratory must be a "demonstration laboratory as well as a "testing" laboratory.

The Faculty of the School of Mechanical Engineering has approved the plans of the Department of Mechanical Engineering Laboratory to require three terms of instruction in Mech Lab in the post-war curriculum. The first course will be on Instruments Laboratory. In this course the student would be taught the technique of measuring pressure, temperature, speed, torque, power, flow rates, and liquid levels. Until very recently, there was no instruction on the measurement of temperature in Mech Lab. The student was introduced to a few instruments in one laboratory period and his training in instruments was then deemed to be complete until he encountered other measuring devices in later tests which emphasized equipment performance rather than problems of measurement. There was little or no instruction on the *control* of pressure, temperature, flow rate, or liquid level. The problem of control is nearly as important to the engineer as the problem of measurement, and in Instruments Laboratory the student should receive instruction in both fields.

The student will then receive two terms of laboratory instruction on

(*Continued on page* 42)

Group running a test on the Marmon eight cylinder gasoline engine



READY MADE HOMES

By MARGOT PORITSKY, Arts '48

EVERYONE has heard about the house which can be built on any empty lot in less than half an hour. It can be started at nine o'clock, and at nine-thirty the daughter of the family will be stepping into the bath tub, baby will be asleep in his crib, Junior will be installing his model airplanes and hanging up his pin-up girls, and Mother will be doing the washing in the utility room. Most people are amused at the idea; however they do not want a house that the finance company can take apart and take back to its factory in half an hour, if all the bills are not paid. And even if the bills are paid, they want a house that will stand up against the wind or snow and not fall apart if the family has a party and someone falls against the wall.

Because of the emphasis which has been placed on the speed of setting up a prefabricated home, many people have gotten the idea that a prefabricated house is about as durable and permanent as a tent. The prefabricated house is really not at all like this.

Future Outlook

The new building industry depends upon speed and in the post-war period when homes will be in great demand, speed will count even more. For in speedy construction lies the economy of which prefabrication is capable. Flexibility and adaptability are stressed. These are two real advantages that prefabricated dwellings have over the conventional type.

The prefabricated home industry is ready to go into action as soon as war-time restrictions upon materials and manpower can be lifted. It will bring to post-war house-building fully developed techniques the efficiency of which has been proved in the construction of thousands of prefabricated homes, not only for the war emergency, but for pre-war peace-time requirements.

There is already a great need for housing. The demand will lie anywhere between 10,000,000 and 20,000,000 dwellings in the United States, according to the *Architectural Record.* Before the war, there was a shortage of 2,000,000 homes. During the five years of war, another 1,500,000 houses have come in need of replacement. The loss due to the war and the natural losses, as well as the people who have been saving in order to buy their own homes, all help to swell the total.

The prefabrication industry is ready to step in and help fill this need. It has the raw materials, the new plastics, impregnated wood, steel, concrete. All of them have been developed to a far greater extent than the public imagines. The manufacturing facilities are looking for an outlet for their energy. They have the machines and the methods. Big companies like Gen-

Workman setting up a prefabricated house

eral Motors and Ford's Willow Run Plant have already begun to look into this matter.

The prefabricated home industry can provide better homes for less money and can do it faster. And it seems likely that they will be given the chance to do it. Because of the war-time stimulus there are now several hundred prefabrication plants in the country.

The industry has changed greatly from the manner in which it started out in the early 30's. It has changed from a sleek, frankly factory-built structure into a much more conservative type. The prefabricating industry started around twelve years ago with a bang. It dreamt of mass-production of a house which would become as commonplace as the automobile. It was usually a one story, cellarless, flat-roofed design, with a smooth, flat-surfaced look. It was highly efficient, but it required popularity and mass production to make it pay, and it was very unpopular. The manufacturers have found that no matter how modern and utilitarian it is, the customers still want a house that looks like a house, and in general, they have shifted to a conventional type of construction, instead of some of the fantastic constructions which the designers had dreamed about.

After its auspicious start, the industry stayed where it was until the war came and gave it the needed boost. Now it has climbed on the band wagon and intends to stay there.

War-Time Experience

The war-time experiments in low-cost prefabricated housing have been invaluable to the manufacturers and point the way toward a large scale postwar development within the frame-work of existing building industries and through normal distribution channels.

One war-time prefabrication company is already performing miracles. It turns out a complete one-bedroom house every twenty minutes. A single day's work includes a complete set of furnishings, an electric stove, a refrigerator, and in some houses an electric heating system that allows for individual heating of separate rooms at different temperatures.

Due to the necessity of saving time and labor, there has been a realistic attempt to expand the use of precision machine methods from the production units like doors, and windows, to the house as a whole.

Completed house in pleasant surroundings

Among the prefabrication industries which have played an important part are General House, Inc., American Houses, Gunnison Houses, TVA House United, and the Celotex Corporation's Cemesto Houses. There have been many other companies which have also done a great deal, and there will be quite a few more.

Varied Types

Among the types of prefabricated houses are the inexpensive frameless steel house, portable copper houses, knock down house of insulated cork, the pre-cast concrete panel structure, homes of plywood, mobile houses, dwellings of fiber boards and panels. There are also the integrated houses, precision built, pre-built, pre-cut, and balloon-blown house.

The theory of prefabrication is the transfer of building labor from the site to the factory. It involves construction of the units of a house in a factory for shipment to the building site. Most of the prefabricated companies are highly centralized and depend upon local builders for assembly of buildings.

Few of the large companies are standardizing one model style, material or finish. They have found from their experience that there is no universal prefabricated pattern. They discovered the advantage in prefabrication to be its adaptability to a coherent idea of distribution and service.

One company that might be shown as typical of the expanded factory-built house industries is the Celotex Company's Cemesto House. Cemesto's house is pre-engineered for mass production with walls and roof materials factory made and delivered to the building site. A field shop is provided for the carpentry and building and assembly units. The entire house, foundation, walls, doors, windows, and roof, is erected in the field in less than one day with a crew of five men.

The material, Cemesto Board, comprises exterior and interior finish and insulation. It consists of a cane fibre insulation board core, sealed with a special bitustatic compound, between two layers of a combination of asbestos and cement. It is light, easy to handle and work, and meets requirements for a unit thickness wall. The house contains 4½ rooms, including living room with dining room alcove, two bedrooms, a kitchen, bathroom, and linen closet. It also includes an oil burner, electric refrigeration, electric hot water heater, electric stove, and built-in kitchen cabinets.

As to the immediate post-war situation, there is no unanimity of thought on prefabrication of houses. There are many different trends—one school favors site prefabrication and use of pre-cut materials; another believes in shop-fabricated structures, using the stressed plywood principle in the form of panels. Others consider meritous the skeleton frame of wood or metal to which panels of conventional material are applied; and still others argue for the use of pre-cast concrete.

New Developments

The war has promoted many new developments which will greatly assist the prefabricated industry. Among these are the glueing methods developed for the aircraft industry, which will greatly reduce drying time, the use of heated concrete dies for molding laminated sheets; and vacuum bag molding of

plywood. Methods of fixing the moisture content of wood will permit precision manufacturing and quantity production of interchangeable wood parts.

Electronics holds a possibility for a wide range of automatic control of heating, lighting, and other mechanical equipment. Heatronics or high frequency molding and curing methods of plastics opens the door to the production of thick plastic sections and laminated structural members. Polarized glass and plastic shatter-resistant sheets will offer new possibilities in window glazing. The perfection of helicopters may make the airplane as common as the automobile, and present not only new freedom in where we live, but problems in design of houses or space in which to land and in which to store a skymobile.

With the problem of many women remaining in industry, there is an increased demand for houses adequately wired for greater utilization of labor saving household appliances. Rubber substitutes and plastic wire insulation will play a large part. Improvements and greater use of continuous outlet strips would appear logical. There will be more built-in electrical equipment.

There will be greater emphasis on radiant heating. There is a possibility of using infra-red drying lamps as sources of radiant heat in the bathrooms and kitchens and in spaces where heat is only occasionally required. Radiant heating floor, wall, and ceiling panels using either hot water or warm air are in an advanced stage of development.

Methods being considered contemplate maintaining household air temperature less than that required for comfort, but with supplemental devices in each room to step up the temperature to comfortable levels when desired. The supplemental heating sources can be provided by radiant heating surfaces or unit heaters.

Air conditioning will be developed further. One manufacturer has been perfecting a device which by ionization, removes dust from the air. A system primarily developed for heating airplanes at high altitudes, will have long range possibilities for use in heating buildings. Heating equipment combines heating of space with the domestic hot water system.

Plastic pipes and tubing will be immediately available for use in plumbing systems. They have wide range of usefulness for gas and oil as well as for water piping. Easily bent, plastics can be joined by simple heat and welding methods, or readily assembled with fittings.

There will also be a variety of plastic fittings, shower heads, stalls, bathtubs and lavatories which will find their place in the house. With the remarkable advances being made in glass manufacturing, this material will also appear in the form of pipes, fittings, and fixtures.

The trend appears to be toward the development of a one story house with greater integration of outdoors and indoors, and toward houses which can be changed at will. With the tendency toward larger glass areas and the stress laid upon the utilization of solar heating, increased use of double glazed windows or transparent plastics may be expected. And more window frames and sashes will be made of impregnated wood, aluminum, and steel alloys.

View showing modern kitchen in pre-fabricated house

The Kitchen

There will be a greater change in the kitchen than in any other part of the house. Integrated sinks, cupboards, ranges and refrigerators of improved design and made in standardized units have been developed. Glass inclosed ranges that permit the cook to watch the cake without opening the oven door, or a whole range of electrical appliances in many instances, may replace kitchen stoves. Improved dishwashers, garbage disposal units, and other labor saving equipment will be used in homes of more than average cost. But even in low cost homes the kitchen will be designed to a higher standard than now prevails. Stainless metals, plastics, glass, wood, resin paints and laminated sheets will create kitchens that will be easily cleaned and very attractive.

Nowadays, prefabrication stands a better chance than ever before. The practicability has been shown. The important question now is one of sufficient sales demand to provide the quantity production that is necessary to its commercial success. For some years probable efforts will be centered primarily upon market development and utilization of such industrial processes as can be readily incorporated in various prefabricated systems.

A grand, new future for prefabrication is in view. If new breadth, depth, and directness is used, it will be assured.

Bill

PROMINENT

William Wilder, EE

"WELL, let me see," said Bill Wilder, thoughtfully. "I entered Cornell in September, 1931, and after being in and out, like a fiddler's elbow, I decided that my education was practically complete, except for a few minor details, such as the junior and senior courses in the E.E. curriculum. Therefore, I left school and worked for about ten years. As the years went by, (and fast), it became apparent to me that I knew less and less. In November, 1944, I returned to school to get my B.E.E. That's about all there is to my story."

A little investigation showed that Bill was born July 19, 1914, in Rochester, N. Y., and was named William Henderson Wilder. He came directly to Cornell from West High School in Rochester. In his freshman year at Cornell, he joined Sigma Phi Epsilon Fraternity, now called "Dorm Ten." He also went out for track, and claims that he could do 100 yards in fourteen seconds flat. He also made the Glee Club in his Frosh year, warbling second bass. Having exhausted all the possibilities of the track squad, he went out for football his sophomore year. He graced the scrubs all that fall. From here on, the crystal ball clouds over, except for a few clear spots.

He married his pretty wife, Olive, in April, 1943, and she is helping him through school, without which help his return would have been impossible.

He worked for Paragon-Resolute Corporation in Rochester from 1937 until the fall of 1944. Most of this time he was doing mechanical and electrical design work, except for a period from August, 1942, through December, 1943, when he was Purchasing Agent and Production Manager.

He joined the Delta Club last spring, and now heads that happy group. He is also a member of Eta Kappa Nu, and the A.I.E.E.; and at the present writing he has been invited to join Tau Beta Pi.

Expecting to get his B.E.E. degree in Communications in June, 1946, Bill says that his post-graduate plans are still somewhat nebulous, but that he hopes to get into design and development work in the field of communications. "Whatever I do," says Bill, "I presume it will be necessary to work."

William Barr, ME

SOME twenty years ago, Chama, New Mexico, was amazed at the basso-profundo voice of one of its latest arrivals, William Barr. Now, even as then, Bill's deep voice is an indication of his Western personality, a personality that has won him a myriad of friends among his associates at Cornell.

Before "heading East," Bill attended Los Alamos Ranch School in New Mexico, where he won a number of scholastic and athletic honors. When he was a senior at Los Alamos, the government took over the school for work in developing the atomic bomb, and Bill accelerated his studies to complete his work in January.

From Bill's enviable record at Cornell it is obvious that he was more than worthy of the McMullen scholarship he received. As a civilian he joined Sigma Chi fraternity and served as Social Chairman in his sophomore year. During his freshman and sophomore years he was a member of the skiing team.

At the start of his junior year Bill joined the Navy College Training program, moving his residence from his fraternity to the Navy dormitories. But this in no way hampered Bill's activities, for during his junior and senior years he has received even more honors.

He was one of the charter members of Pi Beta Tau, honorary engineering social society. He has been both treasurer and president of Pi Bet, at whose functions he has been known to stow away considerable quantities of the golden nectar.

Along quite different lines, Bill's classmates elected him a representative on the Student Council, another manifestation of his popularity and ability.

With all these honors Bill still found time for Mechanical Engineering. He has taken an active interest in its organization, the A.S.M.E., of which he is chairman this term. He was also elected president of Atmos, honorary Mechanical Engineering society. In engineering, Bill's ability is attested by the fact that he will receive his B.M.E. this October.

At present, Bill's future is in the hands of the Navy; but regardless of what the future has in store for him, Bill is sure to find as much success in later life as he did at Cornell.

Bill

ENGINEERS

Rodney Stieff, ME

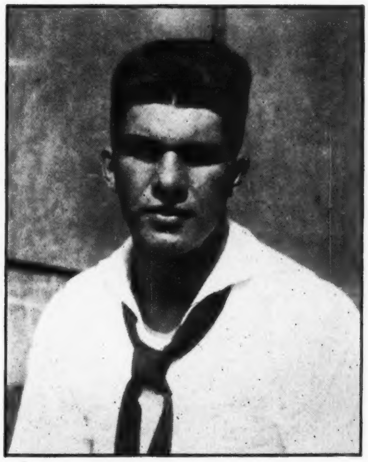
RODNEY G. Stieff, known almost universally as "Rod", "Stiff", or these names in various combinations, is one of the four remaining members of the large class of loyal Princetonians which first jumped off the Lackawanna "Death Train" on that gloomy evening of July 1, 1943.

After being marched from the station up Buffalo Street into the low-hanging overcast, Rod was probably ready to resign the Navy and head back to his home in Baltimore, Maryland. But because he was too tired, he put this off, and now, after twenty-five months he has decided to put it off until October 21, when he will graduate, a loyal Cornellian.

Rod has always been an athlete. After carrying away top honors at his prep school, McDonogh, in football, wrestling, and lacrosse, and after playing lacrosse at Princeton, he worked out with the wrestling and lacrosse teams here at Cornell, becoming captain of both in his junior year.

However, Rod's favorite pastime is sailing. At the early age of six he bought a small 4-foot dingy, which he sailed in the Chesapeake Bay. A few years later Rod could be found passing his summers in

Rod



Rhode Island, where he raced a 16-foot barnegat "Sneakbox" twice a week. Although "Stiff" tipped over more than once as a victim of a stiff wind, he soon profited by his previous mistakes and won the yacht club trophy for first place two summers in a row.

Rod's activities are not limited to athletics, however. At McDonogh he was chosen as one of twelve boys of a senior class of seventy to accelerate and leave school in February. As a mechanical engineer, he is a member of A.S.M.E., Atmos, and the Cornell Corinthian Yacht Club. He was one of the winners of last spring's Student Council election and was subsequently elected Vice-President. He was one of four students appointed last March to the Faculty Committee on Student Conduct, and he also joined Sigma Nu Fraternity the third term he was at Cornell.

Rod's ideal college course would include Business Law, Psychology, Friendship, Love and Marriage, Economics, and other courses that only Marines seem to be able to take.

When asked why he decided to be an engineer, especially a mechanical engineer, he had no ready answer. He tried to trace it back to the time he attempted to swallow a slide rule in early childhood; then he tried to blame it on the Navy; but he finally broke down and told us that after the war, he expected to join his father who is a sterling silver manufacturer.

Rod has a very strong ambition—to get out of the Navy as soon as possible. After that (before he goes into engineering work) if he can find the right crew—i.e., one who can cook—he plans to sail a small sloop around the world. This will give him an opportunity to put his engineering to its first practical use, such as cranking in the anchor chain and plugging up any leaks. It would also give him an excellent opportunity to have lots of good old Cornell-type beer parties which he is quite fond of.

Bill

William Phelps, CE

WHILE walking through the campus recently, you possibly passed a V-12 talking in Spanish to someone else, and you may have wondered what the Navy was coming to. In all probability, however, you had just seen William W. Phelps with one of his South American friends. You see, Bill is from South America, having lived there most of his life. Born in Trenton, N. J., twenty years ago, he went to South America at the age of three months.

Bill started coming to school here in the U.S.A. seven and a half years ago. During the summers, he always went back to Caracas, Venezuela, his present home. Bill first attended Lawrenceville School in New Jersey. Here his love for the great game of soccer was developed, and he played two years of soccer at Lawrenceville. Then Bill decided to go to Princeton but fortunately for Cornell, he was transferred in July 1943 by the Navy to the V-12 unit at Cornell.

To one who does not know Bill well, his quiet and soft-spoken manner hides his ability as a leader which is evident from the many organizations he leads and is active in on the Hill. Bill was president of the Student Council during the summer term and was president of his fraternity, Sigma Alpha Epsilon, for two terms, resigning last term. He is also president of Rod and Bob society and a member of Chi Epsilon, both honorary Civil Engineer-

(Continued on page 44)

Recent Developments
In Engineering

Techni-Briefs

Ethyl Chloride

A new method for making ethyl chloride is announced by Ethyl Corporation. A $750,000 unit employing this process is now under construction at the company's Baton Rouge, La. plant. The principal use of ethyl chloride is in making tetraethyl lead by combining it with an alloy of lead and sodium. Tetraethyl lead comprises about two-thirds of Ethyl fluid, and takes the "knock" out of gasoline.

Ethyl chloride is also used as a general anaesthesia in short operations and dentistry, in producing ethyl cellulose which is the basis for certain plastics, and as a catalyst in synthetic rubber manufacture.

The process yields ethyl chloride by reacting chlorine with waste products from one of the present ethyl chloride plants. Chlorine for the new process is produced by breaking salt electrically into sodium and chlorine. The sodium is utilized in the lead-sodium alloy which is used in tetraethyl lead.

The two methods now in operation for making ethyl chloride are based (1) on the hydrochlorination of alcohol, and (2) on the hydrochlorination of ethylene. In the alcohol process, ethyl alcohol vapor and hydrochloric acid combine in the presence of a catalyst to form ethyl chloride and water. In the second process, ethylene gas is mixed with hydrogen chloride gas in the presence of a catalyst. The two gases are first passed through a reactor where hydrochlorination occurs, and later through a "flash drum" which distills off the lighter ethyl chloride fractions from the heavier polymer fractions.

The new process was developed because of increasing wartime demands for raw materials. When national chlorine supplies became short, the company expanded its facilities for the production of hydrochloric acid from sulfuric acid and common salt. Then ethyl alcohol, used in butadiene for synthetic rubber, became increasingly short. The ethylene process partly replaced the alcohol one. As the war progressed, the supplies of ethylene became inadequate to meet continuously increasing demands, leading to the development of the new process.

Radio Telegraph

DEVELOPMENT of a system of word transmission using eight channels simultaneously to carry messages over a single radiotelegraph transmitter was announced by RCA Communications, Inc. By means of special equipment which employs "time division multiplex telegraph" principles, 488 words per minute can be handled inward and outward simultaneously, corresponding to eight channels each way with a channel speed of 61 words per minute.

All eight channels may be used for two way communication with one distant station; alternatively, four channels can be operated between two different stations, with automatic retransmission to a third station.

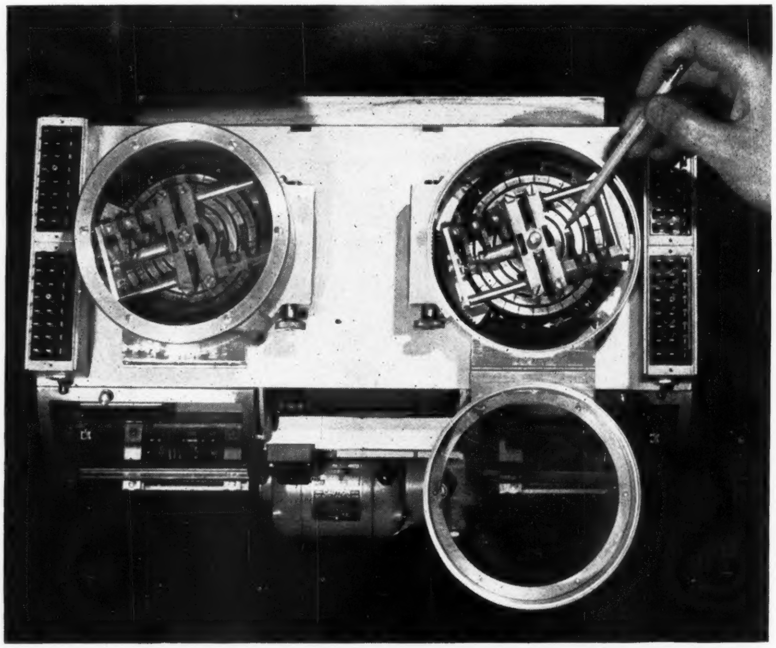
The incorporated printing mechanism makes the circuit virtually error-proof. Any mutilated letter actuates a warning bell on the receiving printer; instantly a maltese cross marks the exact spot of the error and facilitates correction. The printer is completely automatic. Each incoming letter is comprised of 3 marking (signal) impulses plus 4 spacing (no signal) impulses, known as the seven unit system. Arriving impulses are checked automatically and if the marking impulses vary from three the maltese cross is printed.

Multiplex equipment is designed to utilize the RCA Seven Unit System but is able to handle four different signalling codes simultaneously.

A newly perfected mechanism keeps the receiving channeling de-

(*Continued on page 32*)

New radiotelegraph using eight channels simultaneously permitting the handling of 448 words per minute. —*Courtesy of R.C.A.*



NEWS OF THE COLLEGE

School of Industrial And Labor Relations

THE New York State School of Industrial and Labor Relations, permanently established by statutory enactment will take a "broad, fair and impartial" approach to problems of both the worker and employer, according to President Edmund Ezra Day of Cornell University.

Actual formation of the first school in the United States designed specifically to educate students for promotion of a better relationship between labor and management was accelerated by Governor Thomas E. Dewey's approval of a $200,000 appropriation for the school. The new law also vests administration of the School in Cornell University.

With the expectation that a limited enrollment of students for preliminary courses can be accepted this fall, Dr. Day said the fields of education, labor, management and government already are being combed for selection of a director and faculty for the School.

Their selection, it is expected, will be keyed to the School's contemplated approach to the subject of industrial and labor relations, as outlined by Dr. Day.

"It must be broad and continuously fair and impartial toward both labor and management," he said. "The proposed instruction will be fundamental in character, reaching back beyond the mere teaching of techniques for the role of union organizer, management representative or any other individual job in either field."

Graduates of the new School will be qualified for such positions as research specialist, analyst, economist, etc., for either labor or management. They will also be trained for various jobs in government, as it deals with labor relations, such as mediators, statisticians and field workers.

Dr. Day emphasized that the School objective will be "not only to prepare students for the particular work to which they aspire."

"We will aim to give them a well-rounded knowledge of, and feeling for, the problems of other parties to the labor-management relationship," he said.

Naval Training School

THE midshipmen's school at Cornell will be discontinued Dec. 7 by order of the Navy Department at the completion of training of a class entering Aug. 10 according to Capt. B. W. Chippendale, USN, commanding officer of the naval training school at the University. Officer training will continue in an NROTC unit to become fully established Nov. 1, and in the Diesel school for officers. The V-12 training also will continue, although on a smaller scale.

Plans are being considered for the construction of a naval science building at Cornell for the use of the Naval Reserve Officers Training School when it begins functioning about Nov. 1.

After the Naval ROTC students arrive, University and naval officers will jointly consider the equipment necessary to adequately care for the instructional needs of the men. One of the questions involved is the need of a drill hall for the naval officers. The government will share in the expense of building construction.

New Dormitory

AMONG the first of new buildings to be constructed in Cornell University's post-war development program will be a woman's dormitory in the Balch Halls residential area to be located between Balch and the Country Club of Ithaca. Total cost is estimated at $800,000.

The new fire-proof structure will be in a sprawling U-shape, constructed of brick, and the wings faced with native field stone. It will house 425 students. Actual construction will begin as soon as the War Production Board permits the resumption of private construction, and building materials are available.

Architects are Bagg and Newkirk of Utica (Egbert Bagg and C. R. Newkirk, both members of the Cornell class of 1907). General contractors are Barr and Lane of New York City who will handle much of the construction work through sub-contractors on a competitive-bid basis.

Construction time is estimated from 12 to 18 months after ground is broken.

Location of the building is within the long-range planning of the University to house all women students north of Fall Creek. Present plans for a quadrangle in the Balch area show Balch Halls as the south unit, the new dormitory as the west unit, a proposed women's gymnasium as the north unit, and still another proposed dormitory as the east unit. When completed the quadrangle would provide living quarters for approximately 1200 women students.

However, with steady increases in the enrollment of women (now slightly over 2000), additional dormitories are envisioned in the general area of the new quadrangle.

PROF. Paul H. Underwood is acting director of the School of Civil Engineering during the illness of Prof. W. L. Malcolm who has served as director since 1938.

DR. Charles Russell Burrows has been appointed director of the School of Electrical Engineering, succeeding Prof. W. A. Lewis. Dr. Burrows was formerly on the staff of Bell Telephone Laboratories.

DR. Phillips Bradley was appointed professor in the new State School of Industrial and Labor Relations at Cornell.

THE recently-established State School of Industrial Labor Rela-

(*Continued on page* 46)

ALUMNI NEWS

THE Philadelphia Regional Group of the Cornell Society of Engineers held their annual spring meeting at the Engineers Club of Philadelphia on Friday, April 13. Gordon J. Mertz '20, Vice-President of the Society, was chairman of the meeting. Following the dinner, Ezra H. Day '19, Chairman of the Nominating Committee, presented his report nominating Creed W. Fulton '12, Chairman, John R. Bangs '21, Vice-Chairman, and L. R. Gaty '23, Secretary-Treasurer for the ensuing year. John R. Bangs '21, then introduced the speaker of the evening, Dean-Emeritus Dexter S. Kimball, who spoke on "The Past Fifty Years in Cornell History." Dean Kimball related many anecdotes of the early Cornell days and outlined the changes which have taken place progressively during the years and discussed the conditions we must expect during the next decade. There were about sixty members present who received Dean Kimball's talk enthusiastically. This was followed by a discussion by Chairman-elect Creed W. Fulton '12, who outlined his plans for the coming year. These include soliciting more active support from the Philadelphia Regional Group members, enlarging the membership and having the Society take a more active part in the University and community affairs.

BRIGADIER GENERAL ALFRED B. QUINTON, JR., '12, C.E., chief of the Army's Detroit District has been awarded the Legion of Merit for "extraordinary fidelity and essential service." The Detroit News states "General Quinton probably has had direct supervision over a larger volume of war contracts than any other individual. He and the organization he has built up here have been the funnel through which have flowed the arms which are bringing us victory."

JOHN B. BRUSH '34, M.E., *and Mrs. Brush have been released from Los Banos prison camp, the Philippines. Brush, who went to Manila in April,* 1941 *for Proctor & Gamble, was interned with his wife at Santo Tomas when Manila fell. They were separated in* 1943 *when Brush was transferred to Los Banos; several months later Mrs. Brush was sent there also. Brush lost twenty pounds, and his wife, fifteen. They had to sell their personal possessions for food while interned, and were released just in time, "as the Japs were getting very difficult after each defeat."*

WILLIS H. Carrier, M.E. '01, has been elected for his second term as Alumni Trustee. He is chairman of the board of the Carrier Corp., Syracuse, and founded and was chairman of the Carrier Engineering Corp. which preceded it, a pioneer in the air conditioning industry. He holds several distinguished scientific awards, the honorary Doctor of Engineering of Lehigh University, and D.Sc. of Alfred, was president of the Cornell Society of Engineers in 1940, and Vice-president of the Cornell Alumni Fund Council, 1938-41.

JOHN P. Syme, M.E. '26, has been made an officer of the Johns-Manville Corporation and will function as assistant to the president. Mr.

John P. Syme

Syme has had wide general experience in the corporation's management during the last nineteen years, having begun his service with Johns-Manville as an acoustical engineer shortly after his graduation. He served successively in the general engineering and power products departments, and then became manager of the Market Analysis department. Seven years ago, in order to give full time to the problem of industrial and public relations, he was appointed director of Industrial and Public Relations. In this post Mr. Syme organized, developed, and directed the employee relations and public relations of Johns-Manville. He will also continue to serve as Vice-president of the J-M Service Corporation, a subsidiary which operates the Kansas Ordnance Plant at Parsons, Kansas. Among his activities are membership in the University Club, Cornell Club, and Cornell Society of Engineers, of which he is past president.

WILLIAM A. Basse, B.S. in A.E. '44, wrote March 28 from the Pacific to his parents, Mr. and Mrs. William H. Basse of 59 Tuxedo Avenue, Highland Park, Mich.: "It seems that the Cornell boys are the ones that have to take it on the ear—anyway by this ship. William F. Minnock, Jr. '44, John T. Parrett '44, and I were transferred to LST's previous to going to Iwo and rode to the target on them. Then we led in waves of Marines—I had the first assault wave, or the second to hit the beach. Naturally they fired at us, but it was surprisingly light as to what I expected. My waves all got safely on the beach, which later proved to be the SOB. I didn't hang around too much to find out what was going to happen. I went back to the ship and went in with the cargo boats. I assure you that I was the most miserable person on one of those boats which played around there too long—that is, outside of the wounded. You see it rained almost continuously and the spray was constantly coming in over the bow of the boat. We spent four days and nights in a boat loaded with ammunition.

(*Continued on page* 46)

Birthplace of 50,000 RADARS

Two years before Pearl Harbor the Government asked Bell Telephone Laboratories to help perfect radar as a military instrument. The Bell System, through the Western Electric Company, its manufacturing branch, became the nation's largest supplier of radar systems.

Bell scientists designed and developed many different types of radars—each for a specific job. One particular type was standard for B-29s in the Pacific for navigation, target location and high altitude bombing. Another directed all Navy guns over five inches.

This is not surprising, for radar development and production stem from the same roots that produced and continue to nourish this country's telephone system.

BELL TELEPHONE SYSTEM

Cornell Society of Engineers

107 EAST 48TH STREET 1945-1946 NEW YORK 17, N. Y.

J. PAUL LEINROTH, *President*.................... ....37 The Fairway, Montclair, N. J.

ROBERT B. LEA, *Executive Vice-President* ....Great Neck, L. I., N. Y.

PAUL O. REYNEAU, *Secretary-Treasurer and Representative,*
Cornell University Placement Service 107 East 48th St., N.Y.C.

KARL J. NELSON, *Recording Secretary* ....4 Tulip St., Cranford, N. J.

FURMAN SOUTH, JR., *Vice-President*................1140 Wightman St., Pittsburgh, Pa.

WILSON S. DODGE, *Vice-President*....................327 Montgomery St., Syracuse, N. Y.

CREED W. FULTON, *Vice-President* ....4200 Wissahickon Ave., Philadelphia, Pa.

SYLVESTER J. McKELVAY, *Vice-Pres.*....174 North Arlington Ave., E. Orange, N. J.

"The objects of this Society are to promote the welfare of the College of Engineering at Cornell University, its graduates and former students and to establish a closer relationship between the college and the alumni."

President's Message

I WRITE these words the day after the declared victory holidays. The war is over! And what a feeling of thankfulness and relief there is in the hearts of all of us that this most terrible of all wars in the history of civilization has at last come to an end!

Our thoughts, which up until now were concerned almost altogether with matters that would enhance our war efforts, can now be turned to peace time activities. And among these latter activities are the plans for the College of Engineering. Those well thought out plans for new buildings, endowments, new professorships, new curricula, etc. can now begin to be translated into action.

We are on the threshold of great developments in the College of Engineering, which have been receiving the attention of many minds, and which will add greatly to its usefulness and prestige. One of the main objects of the Cornell Society of Engineers is to promote the welfare of the College of Engineering at Cornell University. Surely this should mean that the membership of the Society be on the alert to add what they can, each in their small way, to bring these years of planning to as early a fruition as possible. The Cornell Society of Engineers, at the beginning of a new year, pledges itself to cooperate to the fullest extent possible to that end.

That you may know the personnel of the various committees it might be well to set them down.

The Executive Committee is the governing body of the Society and is made up of the following members:

Officers

J. Paul Leinroth, M.E. '12, President
Robert B. Lea, M.E. '15, Executive Vice President
Furman South, Jr., M.E. '12, Regional Vice President
Furman South, Jr., M.E. '12, Regional Vice President (Pittsburgh)
Wilson S. Dodge, M.E. '22, Regional Vice President (Syracuse)
Creed W. Fulton, M.E. '09, Regional Vice President (Philadelphia)
Sylvester J. McKelvy, C.E. '27, Regional Vice President (New Jersey)
Paul O. Reyneau, M.E. '13, Secretary-Treas.
Karl J. Nelson, Ch.E. '39, Recording Sec'y.

Past Presidents

Bernard A.Savage, M.E. '26
James Lynah, M.E. '05
George N. Brown, M.E. '08

Chairmen of Standing Committees

Meetings
Robert B. Lea, M.E. '15, Chairman
William M. Reck, C.E. '14, Vice Chairman

Membership
L. S. Waterbury, C.E. '19, Chairman
Homer R. Seeley, C.E. '19, Vice Chairman

Awards
William H. Hill, M.E. '22, Chairman

Publications
George T. Minasian, M.E. '18, Chairman
R. M. Smith, M.E. '30, Vice Chairman

Alumni Nominations Committee Representative
Wilton Bentley, M.E. '98

Engineering Council Representative
Bernard A. Savage, M.E. '26

Engineering Colleges Representatives

Electrical Engineering
Carl F. Ostergren, M.E. '21
Wilton Bentley, M.E. '98

Civil Engineering
Carlton Reynell, C.E. '06
John P. Riley, C.E. '22

Mechanical Engineering
William Littlewood, M.E. '20
Rudolph M. Triest, M.E. '11

Chemical Engineering
Henry R. Gundlach, B.Chem. '11
Joseph Coors, Ch.E. '40

While these men will contribute much of their time and effort in the crucial year ahead of us, they need your cooperation. Without your interest and support they can accomplish but little. I therefore ask for your cooperation, urge you to affiliate yourself with your local group and become active in it, and solicit your thoughts on what we can further do "to promote the welfare of the College of Engineering at Cornell University, its graduates and former students, and to establish a closer relationship between the college and the alumni."

J. Paul Leinroth '12

The Cornell Engineer

L. Whitley Simmons, 7th — Managing Editor
Richard E. Goll, 8th — Editor-in-Chief
Melvin Goldfarb, 8th — Business Manager

Publication Board

Philip E. Silberberg, 5th — Assistant Editor
Adam P. Friederich, 7th — Associate Editor
Anthony S. Rugare, 7th — Illustrations Editor
John R. Gritzan, 6th — Treasurer
Charles Fisher, 4th — Circulation Manager

Editorial Board

R. H. Terepin, 3rd
D. G. White, 4th
M. Poritsky, 2nd
B. P. Carter, 2nd
F. Brima, 2nd
R. I. Brooker, 3rd
K. Blanton, 2nd
D. Silver, 6th
H. M. Deutch, 2nd
Muriel Sacks, 2nd
R. C. Reese, 7th
Robert Olson, 8th

Business Board

Eve Freyer, 5th
Joseph Nemeth, 4th
Richard Erskine, 6th

Advisory Board

Prof. S. C. Hollister

Technical Advisors
Prof. R. Y. Thatcher
Prof. M. W. Sampson

School Directors
Prof. Wm. Barnard, M.E.
Prof. C. R. Burrows, E.E.
Prof. W. L. Malcolm, C.E.
Prof. F. H. Rhodes, Chem.E.

Alumni
G. T. Minasian, M.E. '18
H. H. Williams, Jr., C.E. '26

Member of The Engineering College Magazines Associated
Chairman, **John W. Ramsey**, Tennessee Eastman Corporation, Oak Ridge, Tennessee
Advertising Representative, Littell-Murray-Barnhill, Inc., 101 Park Ave., New York and 605 N. Michigan Ave., Chicago

Arkansas Engineer
Colorado Engineer
Cornell Engineer
Illinois Technograph
Iowa Engineer
Iowa Transit
Kansas Engineer
Kansas State Engineer
Marquette Engineer
Michigan Technic
Minnesota Techno-Log
Missouri Shamrock
Nebraska Blue Print
New York Univ. Quadrangle
Ohio State Engineer
Oklahoma State Engineer
Oregon State Technical Record
Pennsylvania Triangle
Purdue Engineer
Rose Technic
Tech Engineering News
Wayne Engineer
Wisconsin Engineer

Published monthly—October to May—by the **Cornell Engineer, Inc.**, Lincoln Hall, Ithaca, N. Y. Edited by the undergraduates of the College of Engineering, Cornell University. Entered as second class matter at the Post Office at Ithaca, N. Y., under Section 103, Act of October 3, 1917.

Subscription per year: regular $1.50; with membership in the Cornell Society of Engineers $2.00 (See President's page); students $1.00: single copy $.20. This issue: October, 1945.

Diesel In The Air

(*Continued from page* 11)

pounds per gallon) and thereby more room is available for passengers and cargo.

Owing to greater fuel carrying capacity, the Diesel possesses great advantages for military aviation. The Diesel increases the flight range, and thus the striking power of bombers is increased. It also has the ability to carry a greater military load. Due to greater fuel economy, Diesel equipped warplanes show an increase as high as twenty-five per cent in range and load carrying capacity. It is interesting to note that the German Air Force found that one hundred Diesel-powered two-engined Junkers Ju 86-K saved nearly five tons of fuel during each hour of flight compared with the fuel required for one hundred similar gasoline-engined airplanes developing the same power.

From a humanitarian point of view, the Diesel engine offers one extremely important advantage over the gasoline engine. Owing to the non-explosive character of the fuel oil used, the danger of fire, as for instance in case of a crash or of leakage during flight, which constitutes one of the greatest hazards in aviation, is practically completely eliminated.

The dangerous character of gasoline does not lie so much in its inflammability as in the combination of a high degree of volatility with inflammability. The fuel used in the Diesel is so extremely unvolatile that it is practically impossible for it to ignite accidentally, even under the most extreme conditions likely to be encountered. The importance of the elimination of the fire hazard in military aviation in time of war can not be over emphasized.

Commercial airline companies will definitely in the future find great use for Diesel engines. The safety factor of their operations will be substantially increased, since loss of life in crashes will be considerably reduced. A very large proportion of the more serious airplane crashes are followed by fire, and in many of the cases more damage is done by the fire than by the crash itself.

The adoption of the Diesel engine for airplanes will make flying an even more popular sport than it was before the war. The reduction in fuel cost will enable the average private flier to do more flying than previously.

The Diesel engine will also find wide use, in the future, on lighter than air craft. Thus far, in the United States, we have built helium-filled airships, but have had to power them with gasoline engines. In Germany, on the other hand, they have built Diesel-engined airships but have had to employ hydrogen as a lifting gas. Undoubtedly when the airship building program is renewed the ideal combination of helium and Diesels will be employed.

The Diesel aircraft engine today is still very much in its infancy. However, much research and development work will undoubtedly be carried on after the war. The future of Diesel aircraft looks extremely bright. Its universal adoption will be fast and unbounded. In fact, only the sky's the limit.

The Shape of Things

(*Continued from page* 9)

Most Bell System equipment is kept in heated buildings in a temperature range of only 50°F to 110°F. Military equipment, however, has to stand storage outdoors in all sorts of climates. The temperature may range from —40°F in the Alaskan winter to +140°F in the African sun.

The high extremes of temperature occur in some of the tightly packed boxes used for airborne equipment. The heat given off by the apparatus in the box sometimes is the equivalent of five electric toasters going full blast. To make matters even worse, the air is thinner at high altitudes and doesn't carry the heat away as rapidly as it does at sea level. The result is that the temperature in such boxes often reaches 160°F.

The low extreme in temperatures also occurs in airplanes. Some of the airborne equipment is placed where it gets cooled down to the outside air temperature. At five miles up that air temperature is —75°F.

Most of the standard Bell System apparatus is filled with wax to insulate the parts and keep them from shaking. The wax melts at about 130°F, and is quite satisfactory for Bell System use. This wax cannot be used for military equipment, however, because it would simply ooze out in the higher temperatures encountered.

Sometimes the designer can adapt the standard equipment designed for one set of conditions for use in another. A standard type of switch used in the Bell System contains a drop of mercury as the moving contact. Mercury freezes at —40°F and this switch normally couldn't be used in airborne equipment. However, the addition of a heater prevents the freezing and the switch can be used.

Corrosion is always a tough design problem, especially for military equipment which is exposed to extremes of climate. The worst corrosion occurs on ships where equipment is exposed to salt water spray and to the salt dust blown about by the winds. The salt dust is blown

(*Continued on page* 34)

(*Continued from page* 20)

vices in exact step with the distant transmitter and the signal elements being sent.

The new system was extensively used during the United Nations Conference at San Francisco, and engineers predict wide use for this amazing device in handling post-war traffic.

Home Freezer

WESTINGHOUSE engineers have designed a new upright home freezer with doors on the front like electric refrigerators, thereby achieving easy reaching convenience in the handling of stored foods and gaining lower operating costs. The two functions of freezing and storing foods will be done separately. Sectional inner doors and compartments make it possible to select specific foods from an individual section of the cabinet without disturbing food arrangements in other sections. Zero temperature is maintained in storage compartments. On freezing surfaces, temperatures range from 10°-20° below zero.

Westinghouse home economists and refrigeration engineers coordinated their progress in refrigeration research toward the development of the home freezer. The home freezers are tested in the laboratory for both mechanical performance and ability to freeze and store foods. Records of food in 75 locations within each freezer are kept. Thermocouples, placed in the food packages and read during freezing and storage periods, give a history of temperature of the foods. Monthly reports include freezing rate curves, processing records on foods frozen, and comments on the taste and appearance of the foods when thawed and cooked. For use by the engineering department, continuous recordings are made of the freezer's power consumption, actual operating time, number of door openings, and the total time the outer door is open. In a sound proof room, the noise made by the refrigerating mechanism is studied.

The new freezer will be made in three models for city and farm use.

Upright home freezer

—Courtesy Westinghouse

Protective Plastic

AN American fighter plane stands ready for take-off on some distant desert runway. The temperature has soared to 175 degrees Fahrenheit. In a few minutes the plane has reached an altitude where the temperature may register 50 degrees below zero.

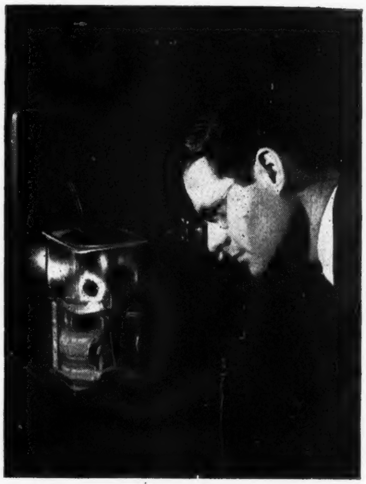
Such sudden changes from baking heat to freezing cold are tough on the fighter's radar and radio equipment. Protective waxes and gums begin to melt and run out of the transformers, moisture condenses on equipment and is absorbed in the electrical windings and coils. The result may well be a break down in the plane's communication equipment.

As a remedy, Westinghouse engineers developed a moisture proofing plastic that flows almost as freely as water and hence fills every tiny opening in the electrical windings and coils, but which on heating hardens permanently to a tough, protective skin through which no moisture can seep.

Under test the new plastic proved from 50 to 500 times better than any varnish previously developed for such purposes.

The moisture-proofing material is named Fosterite, after Newton C. Foster, who developed it. Chief among its advantages is the fact that it contains no solvents. Consequently, when the liquid is heated to form a solid, no solvents are boiled off to leave tiny gaps through which moisture can penetrate.

This new material will have a wide variety of uses, because it wards off dirt as well as moisture. Fosterite may be used to protect



—Courtesy Westinghouse

Mr. Foster observing the effect of water on a small transformer coated with Fosterite

motors and other electrical equipment that operate in such dust laden atmospheres as coal mines. It may also be used to keep harmful moisture out of meters that measure the flow of your electric current, out of delicate relays in telephone systems, or away from the windings of electrical equipment.

New Photoflash Lamps

A new blue dye coating which boosts by forty per cent the light output of two photoflash lamps used with daylight color film and makes more faithful color reproductions indoors and outdoors has been developed by the Westinghouse Company. More accurate color reproduction is possible since the spectral characteristics of the light emitted through the new coating more nearly simulate average outdoor daylight conditions, thus providing an improved color balance. The new lamps are designed for daylight type film only but are useful either as the sole light source when making color pictures indoors or when a shadow fill-in is desired for outdoor pictures.

Stretching Aluminum

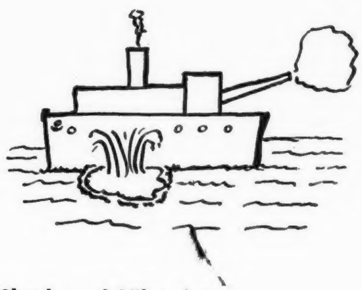
STRETCHING machines developed by the automotive industry are being utilized in the stretching, shaping, and forming of aluminum into structural parts. The stretching of aluminum pieces in the produc-

(*Continued on page* 38)

The Shape of Things

(*Continued from page* 30)

into the equipment where it absorbs moisture from the air and forms films of salt water. Any bit of salt water in contact with two dissimilar metals forms an electric battery. One of the metals is then used up in a short time by the electrical action of the battery. The designer tries to avoid this form of corrosion by placing together only metals that form weak batteries, by giving the metals heavy coatings of plating and paint, or by inclosing the equipment in well sealed boxes. These precautions have been made a standardized part of the design of shipborne equipment.



Shock and Vibration

No doubt you've heard the story of how soldiers marching across a bridge caused it to collapse. The bridge happened to be the right size to swing in time with the marching, so each step gave the bridge an extra shove in its swinging. The bridge just swung further and further with each step until it broke.

Its been found by bitter experience that plane motors can do exactly the same thing to airborne equipment. This shaking to pieces of the equipment can be avoided by making the equipment so that it vibrates in resonance only at speeds lower than those of the plane motors. This construction has been made standard for airborne equipment.

On ships, shock is more important than vibration. Whenever a warship fires its gun, or a shell bursts in the water nearby, the whole ship is given a terrific pounding. Standard shipborne equipment therefore is designed to be especially sturdy and is often

(*Continued on page* 36)

The Shape of Things

(*Continued from page* 34)

mounted on shock absorbers. Then no special design is needed to protect the equipment from vibration.

Service Life

The most important requirement on parts used in the Bell System is that they have a long service life. Take, for instance, the paper type condensers used in the Bell System. It is estimated that there are now fifty million of them in use. Those condensers were designed to last at least 15 to 30 years. So far only a few thousand have had to be replaced each year. If, however, condensers lasting only two years had been used, twenty-five million of them would have to be replaced each year. You can see what a costly maintenance job that would be. For that reason the Bell System has adopted long-lived parts as a standard in spite of the higher price.

Military equipment, on the other hand, gets used up quickly in combat or else rapidly outmoded by new developments. A service life of two to three years is usually sufficient.

The rapid changes in military design require that the design and manufacture of new equipment take as short a time as possible. The designer saves time if he can use previously designed parts. And if parts already in manufacture can be used, all the more time is saved. For that reason, large quantities of standardized parts are used in military designs. And the military forces are strong backers of standardization in industry.

Results of Different Design Requirements

You can see from the above examples how different requirements lead to different standardized designs.

The standardized Bell System designs emphasize low operating costs, long life, and ease of interconnection.

The standardized Army airborne designs accentuate light weight, small size, and operation under extremes of temperature.

The standardized Navy designs emphasize resistance to corrosion and shock.

Summary

Different design requirements are put on the equipment by the different users.

The designer picks a design which satisfies the greatest number of those requirements.

Wherever possible the designer uses standardized parts to save time and costs.

In this way are chosen the many shapes of machines and gadgets of our civilization.

Techni-Briefs

(*Continued from page* 32)

tion of aircraft components is a process necessary to the straightening, strain-hardening, strengthening and forming of parts that cannot be shaped efficiently in any other way. Before the war, aluminum stock was stretched by a hand-hammering method, ordinary dies in large presses being used for the final forming operations. Strain hardening was an incidental result of the process. "Springback" of the material under this old method posed additional problems. In order to provide for adequately forming parts on mass production methods, the hardening and forming operations were combined into a single process called stretch-forming, using a stretcher die (similar to a press die) in a hydraulic machine. The stretching machines consist of a specially-built, table-height base upon which are mounted two hydraulic jaws and a form whose contour matches the finished part. The jaws pull the part against the form with a pressure ranging from 500 to 1,300 pounds, forcing the metal to relax into the desired contour. The explanation of the remarkable strengthening effects achieved in this stretching process seems to be that each circular molecular body in the aluminum is drawn out into an egg-shaped elliptical particle, making the metal extremely hard and strong.

DuPont and Atomic Bomb

The Du Pont Company's assignment in connection with the industrial development of the use of atomic energy, recently announced by the government, involves several factors of an unusual nature. DuPont's connection with this work began in the fall of 1942. At that time the War Department, represented by Major General Leslie R. Groves, asked the Du Pont Company to undertake a phase of this project involving the engineering, designing, construction, and operation of a large plant. General Groves stated that the project was of utmost importance in the war effort, as evidenced by statements that the first nation to solve this problem could force a victorious end to hostilities by its use, and that available evidence strongly suggested that the enemies of the United States were seeking to solve the problem.

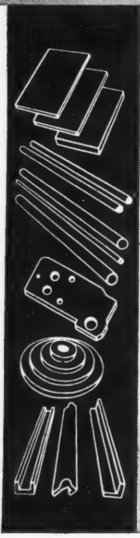
The importance of the field was such, that any patent rights developing out of the work were to become the property of the government. The government was to protect against all costs, expenses, claims and losses sustained by Du Pont.

The specific responsibilities assumed by the Du Pont Company were to engineer, design, and construct a small-scale semi-works at the Clinton Engineer Works in Tennessee, and to engineer, design, construct, and operate a large-scale plant at the Hanford Engineer Works in Washington. Because of its close association with fundamental research, the Clinton semi-works was to be operated under the direction of the University of Chicago. It was agreed that it would be necessary to depend most heavily upon the fundamental research and development, consulta-

(*Continued on page* 41)

From the Metro-Goldwyn-Mayer picture MADAME CURIE

They Pried Open a Great Door



SHEETS

RODS

TUBES

FABRICATED PARTS

MOLDED MACERATED and MOLDED LAMINATED FORMS and PRODUCTS

THE dramatic quest of Madame and Pierre Curie ended not only in the historic discovery of radium but opened a great door leading to new concepts of matter and therapy.

A similar, but less arduous, quest by you in relation to technical plastics might open a door to valuable possibilities. Practical and profitable new uses for these technical kinds of plastics are imminent, awaiting investigation and trial.

One sound approach to your application is to check over your requirements with us. Should a material with excellent electrical properties and resistance to corrosion, mechanically strong and easy to machine be indicated, our type of technical plastics, Synthane, may fill the bill. Our complete catalog, free for the asking, will be helpful to you. Synthane Corporation, Oaks, Pa.

SYNTHANE TECHNICAL PLASTICS

SHEETS • RODS • TUBES • FABRICATED PARTS **SYNTHANE** MOLDED-LAMINATED • MOLDED-MACERATED

Plan your present and future products with Synthane Technical Plastics

Techni-Briefs

(*Continued from page* 38)

tion, and advice of the Metallurgical Laboratory of the University of Chicago.

The cost has been approximately $350,000,000. The area owned or controlled by the government for this project amounts to more than 600 square miles.

In the time and with the information available, the Clinton semi-works could not be designed to be an early edition of the Hanford production units, as would have been the normal procedure. Therefore, the Hanford units had to be designed, constructed and operated without major guidance from Clinton experience. However, the Clinton semi-works proved to be an important tool in the solution of many completely new problems encountered at Hanford.

Meteor Detection

By means of an apparatus designed in connection with the work being done at Cornell on the National Geographic Society aurora borealis study, Cornell physicists recently recorded the presence of meteors. near the earth. According to Dr. C. W. Gartlein, who designed the apparatus with Mr. Joseph C. Logue of the Department of Electrical Engineering, this is the first known electrical recording of meteors. Two photo-electric cells in a balanced circuit are "aimed" at different portions of the sky, and are so synchronized that when one cell intercepts light which is brighter than that being received by the other, a recording pen on the graph is set in motion. The jagged line made by the pen not only records the presence and duration of a meteor in the field covered by the photo-electric cell, but also gives a reading of the brilliance of the light which may be measured accurately by comparing it with the amount of light received by the other cell at the same moment.

Net Work Analyzer

An A-C Network Analyzer built and maintained by the General Electric Company has been of great value to power companies in solving operating problems and in providing data necessary to changed wartime operation. The analyzer, designed and built seven years ago, is a cabinet with myriad dials and wires. It is so designed that circuits can be set up "in miniature", which function the same, electrically, as an actual power system. In this manner problems can be solved which are too difficult for human solution or which would require weeks or months of computation, compared with a few hours operation of the analyzer. Such predetermination of power-system performance, often unfeasible previously, avoids costly mistakes.

The analyzer became a hero in the early days of the war when power companies found themselves in a tight spot. Despite a tremendously increased load as a result of country wide industrial expansion and the sudden cancellation of new equipment then on order, the utilities had to turn the wheels of industry faster than ever before. "Power pools" charted by the a-c analyzer helped solve the problem. First their operation was studied on

(*Continued on page* 44)

Mech. Eng. Labs.

(*Continued from page* 14)

what might be called power plant apparatus. This instruction should be correlated term by term with the recitation and lecture courses in heat-power engineering. Laboratory instruction will be given on internal combustion engines and engine parts—steam engines, turbines, and pumps—combustion and heat transfer apparatus, such as boilers, condensers, evaporators, and other heat exchangers—air compressors and fans—the complete steam power plant—refrigerating and air conditioning equipment. In many of these fields, the laboratory equipment is inadequate at the present time. In particular, the laboratory must be equipped to "demonstrate" as well as "test." In the laboratory instruction on refrigeration, for example, one experiment has been offered in the past. The student spent three hours in the laboratory testing an ammonia compressor driven by a steam engine—and that completed the laboratory instruction on refrigeration. Granted that the student might well "test" or determine the performance of a mechanical condensing unit or a refrigerating machine, he should also be shown the component parts of modern equipment—compressor parts and various controls—thermostatic expansion valves, high and low-pressure cut-outs, water regulating valves, liquid solenoid valves, two-temperature valves, and the like. He should be instructed on charging the refrigerating system, pumping down the system, and testing for leaks. The laboratory instruction which has been given at Cornell has been very sound, but it now needs some equally sound expansion.

The use of the laboratory to "demonstrate" as well as "test" requires that the student spend more time in the laboratory and less time in his room writing a report. It also requires that the instructor spend more time in the laboratory and less time in his office chair reading reports. Laboratory equipment is expensive; in order to decrease the cost of laboratory instruction, the laboratory equipment must be utilized each hour of the scholastic day. There should be a staff in the Department of Mechanical Engineering Laboratory adequate to keep the laboratory filled with students at all times.

To the many prospective graduate students in mechanical engineering the Mech Lab department must be ready to offer formal laboratory courses at advanced levels. Such courses have not been offered in the past. It is not sufficient that the major professor see a graduate student once when he signs the blanks for the office of the Graduate School and again when the student appears with a bound thesis. Carefully planned laboratory instruction should be offered in instruments and heat-power apparatus beyond that given in the courses required of the undergraduates.

Post-War Challenge

Post-war instruction in engineering offers a challenge to the instructing staff. Rapid technical advancement that is not widely publicized during war serves to increase the natural time lag between engineering as practiced and engineering as taught in engineering colleges and explained in engineering textbooks. Teachers must make every effort to shorten this lag. The experience now being acquired by members of the instructing staff who are teaching the "demonstration" type of laboratory work in the U. S. Navy training programs in Diesel engineering and steam engineering will be very valuable to the school. In particular, the quality of laboratory instruction offered at Cornell after the war on internal combustion engines should be of the highest order.

It is easy to talk or write about changes in the curriculum that will improve the quality of the instruction. It is no hardship to change course numbers and to write high-sounding descriptions of courses in the college announcements. Students, however, are not taught by curricula but by men. The curriculum is no better—or worse—than the men who constitute the instructing staff. This point was apparently well understood in the early days of engineering education, but new emphasis may now be desirable.

William Phelps

(*Continued from page* 19)

ing societies. Pi Beta Tau and Beta Upsilon, two social societies, also claim Bill as a loyal member.

It was natural that Bill should go out for soccer after he came to Cornell. After three years on the varsity soccer team, Bill says that Nicky Bawlf is "pretty terrific" and really good when it comes to sticking up for his team.

When asked why he took Civil Engineering in college, Bill replied that the large field for civil engineers in South America attracted him. The Sanitary Engineering Department here at Cornell especially interests him since he wants to have a part in raising the health standards in South America by helping in projects such as improving the water supplies and facilities for sewage disposal there.

Bill's comment about Cornell is that it is a wonderful place even though it is a trifle cold at times. One fault that he finds with the present engineering course is that there is no time for specialization, and that one gets only a smattering of a number of topics. For this reason Bill is sold on the post-war five-year engineering course. Bill also favors the Civil Engineering Honor System and is hoping that it will be extended to other schools.

Bill plans, after graduation this October with a B.C.E. degree, to join the Seabees. Later he intends to come back to Cornell to get his Master's degree in Sanitary Engineering, and then to go to Venezuela and work for the government or some firm until he "finds out what the score is." Bill plans to make his home in South America and to live there the rest of his life.

Techni-Briefs

(*Continued from page* 41)

the analyzer; then the power systems of various utility companies were interconnected so that any excess generation available on one system could be utilized by the loads on another. The greatest utilization of hydro-electric power could also be made by such means.

Nearly 300 different investigations have been made on the analyzer by more than 100 domestic power companies and industrial and foreign concerns. New uses for this modern electrical brain are continually being found, such as the solution of problems dealing with fluid flow, a-c machine analysis, electromagnetic fields, elasticity, and quantum mechanics and dynamics.

Formex Wire

FORMEX wire so delicate that even with six coats of insulation it is no larger than a wisp of cobweb is being used by General Electric in the tiny coils of instruments for measurements in electronic circuits.

This minuscule wire, which is one third the size of a human hair, can conduct the 1/10th of an ampere required to light a small lamp, and can take as little as 1,500,000th of an ampere which is 250,000 times smaller than that used in an ordinary 60-watt household lamp.

One pound of this small wire is 62 miles long and will make 420 typical instrument coils.

Alumni News

(Continued from page 22)

Sleep'ng on boxes of rockets and being soaked to the skin really did it. Also being without food and water was not too pleasant. The boat I was in was too heavily loaded, and on the fourth day we had to throw everything overboard to keep from sinking and to make it back to the ship. When they finally did take us aboard I found that I was immediately on watch. I went out for four more days in the boats the next morning . . . No doubt you have seen the picture of the American flag being raised on Mt. Surubachi. I saw it go up. After the tons of explosive they poured into that end of the island one couldn't help but have a feeling of pride to see it raised."

MAJOR James T. Lewis, Jr., M.E. '27, of 374 Park Avenue, Yonkers, has been awarded the Bronze Star for "meritorious service in connection with military operations against the enemy of France." The citation states that he "personally directed the manufacture of a special device, which, attached to the front of a tank, created a passage for the tank through the thick and otherwise impassable hedgerows in Normandy. Working under pressure of time and extreme scarcity of materials, he improved the production method and designed a special means of attaching this "rhinoceros" device, which made possible the completion of the project when it was needed for a major armored attack."

News of the College

(Continued from page 21)

tions, scheduled to open this fall with a limited enrollment, will be headed by its first dean, Mr. Irving M. Ives of Norwich, author and sponsor of the legislation which created the new school at Cornell. In addition to training individuals and teaching them techniques, the new school's primary objective, according to President Day, is "to promote mutual sympathy between labor and industry for each other's problems and a more harmonious approach to their solution."

STRESS *and* STRAIN...

This business of getting up jokes
Has got us a little daunted.
The ones you want, we can't print,
And the ones we print aren't
wanted.

* * *

Big Indian Chief walked into J. P.'s and ordered a ham sandwich. When it came he took a bite, then looked between the pieces of bread. "You slice 'em ham?"

"Yes, I sliced it" came the reply.

"Ugh," said the Chief, "you damn near miss 'em."

* * *

A colored American soldier in England was engaged in a poker game with some British Tommies. He picked up his hand and saw that he held four aces. Anxiously awaiting his turn to bet, he heard someone say, "I'll bet one pound."

When the colored boy's turn came, he said, "Ah don't know how yo'all count yo' money, but Ah'll raise you one ton."

* * *

Chief: Hey you! Don't spit on the deck.

NROTC: Why not? Does it leak?

* * *

Two farmers met on a country road and pulled up their teams.

"Si," said Zeke, "I've got a mule with distemper. What did you give that one of yours when he had it?"

"Turpentine. Giddap."

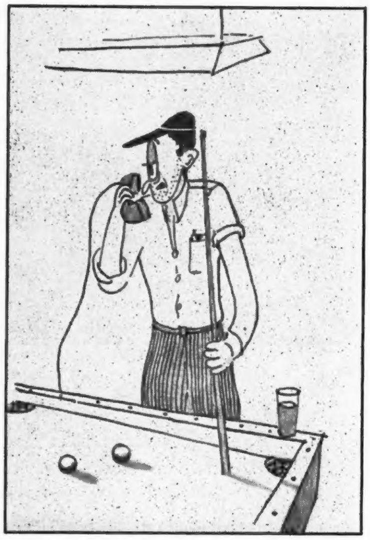
A week later they met again.

"Say, Si, I gave my mule turpentine and it killed him."

"Killed mine too. Giddap."

"I'm my own bouncer and I'm hard," declared the tough bartender. "You gotta be to stay in this business. Look, last night this guy comes in and I don't like his looks, an' I don't like the way he orders his beer, so I lets him have it with the old bungstarter. Down he goes, so I takes him by the seat of the pants an' throws him out into the street, the big bum—an' then I throws his crutches out after him."

* * *



"Whataya mean 'Watchtower'?"

* * *

A mother wished to enter her five year old daughter in a kindergarten the age requirement of which was six. To the disapproving teacher, the mother explained, "She can easily pass the Six Year Old Test."

"Say some words," the teacher said rather skeptically to the child.

The little girl surveyed the teacher with dignity, and turning to her mother, asked, "Purely irrelevant words?"

* * *

"But Mr. Otto, the engine's smoking!"

"Well it's old enough."

V-12: Your stockings are wrinkled.

Coed: I hate you, I'm not wearing any.

* * *

"Madam, I represent the Mountain Wool Company. Could I interest you in some coarse yarns?"

"Sure, tell me a couple."

* * *

Airplane plants are still turning out planes at top speed. Last week at Lockheed it is reported that they built a plane in eight hours flat. Five minutes later a pilot took off in it. Ten hours later, the plant received a cable from him: "I am in Hawaii. Please send the motors."

* * *

"It's not the work I enjoy," said the taxicab driver, "it's the people I run into."

* * *

G-Man: "He got away, did he? Didn't you guard the exits?"

Constable: "Yep. Guess he must have gone out one of the entrances."

* * *

We always called a spade a spade until we hit our foot on one the other day.

* * *

The English language is a funny thing. Tell her that time stands still when you look into her eyes, and she will adore you; but just try telling her that her face will stop a clock!

* * *

Poppa Gross: You can't sleep in my class.

406 Student: I know it. I've been trying for the last half-hour.

CAMPUS NEWS

RESEARCH AND ENGINEERING KEEP GENERAL ELECTRIC YEARS AHEAD

A NEW "HOUSE OF MAGIC" FOR PEACETIME AMERICA

"Many things have been discovered during this war, and we can and must develop them into better things for peacetime.

"Today we have 550 research people on our staff. New facilities will not only give increased outlet for their abilities, but will provide opportunities for new research minds with new talents.

". . . even more than in the past the laboratory will emphasize research in pure science—continuing and expanding the work begun by Dr. Whitney and the late Dr. Steinmetz forty-five years ago."

C. E. Wilson
President, General Electric Company

A New Idea

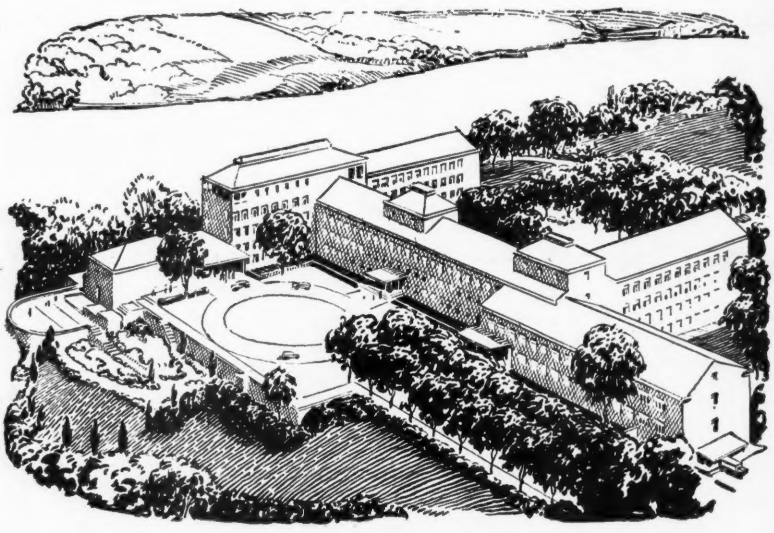
In 1900 Dr. Steinmetz, Elihu Thomson, A. G. Davis, and E. W. Rice, Jr. originated the idea of a laboratory that would be devoted to the problems of fundamental research, without immediate concern for commercial results.

Up to then fundamental research in this country—what there was of it—had been largely left to colleges. In 1900 industrial laboratories had not grown beyond the status of "trouble stations" maintained only for the immediate needs of the factories.

They started the G-E Research Laboratory from scratch—in a barn behind the Steinmetz home—a far cry from the $8,000,000 laboratory building planned for peacetime America.

Years of research and engineering have built the laboratory into a veritable "House of Magic." It meant the work and ideas of men like Dr. W. R. Whitney, Dr. W. D. Coolidge and Dr. Irving Langmuir. In 1914 the laboratory moved to a new brick structure—then the last word in laboratory construction. Research had come into its own.

The laboratory will now move to a more spacious location. Plans have been approved, the site has been chosen, and it is hoped that construction can start within six months. The site, five miles east of Schenectady, offers special advantages for a "House of Magic" of the future. On a rocky cliff near the Mohawk River, it's particularly adaptable to General Electric's work with radar, television, high-frequency, jet engines, and x-ray.



This new building—as an artist sees it—will be from two to five stories in height and will include 300,000 square feet of laboratory working space.

In the past forty-five years G.E. has contributed to better living in America—not only through new developments in electricity, metallurgy, electronics, and chemistry, but also through reduced cost and increased efficiency, as in the modern incandescent lamp. In 1923 a 60-watt lamp cost 40 cents. Today the 60-watt bulb gives 50% more light for the same current and costs only 10 cents, plus tax—thanks to G-E research.

Research Staff Will Grow

An expanded staff will carry on this research in a laboratory built on a 219-acre estate. Looking ahead 15—or even 20 years—still further expansion may be required, such as smaller structures for special purposes, and a pilot plant for new chemical processes. All this requires not only a building that is immediately suitable, but one with grounds around it for other buildings.

But the ideas evolved in this new laboratory will not be the ultimate in research. The word *research* implies a continuing process. It is unlikely that the physicists, chemists, and engineers of our country will ever stop prying into the secrets of fundamental science. In the words of Dr. Coolidge, "A research laboratory is essentially a group of men in a congenial atmosphere, engaged in *extending* the frontiers of knowledge." *General Electric Company, Schenectady, New York.*

The best investment in the world is in your country's future. Keep all the Bonds you Buy.

GENERAL ELECTRIC